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 2024 – Summer Edition

19-21 June 2024

Book of Abstracts

Applications of Chemistry in Nanosciences and Biomaterials Engineering

ISSN 3008-6124

ISSN-L 3008-6124

Program

The program will be published on the official webpage of AOSR on 12.06.2024, as well as in the TEAMS Class. The link for the TEAMS Class will be provided in due time, on or before 19.06.2024.

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: 19.06.2024
2. Extended registration: 07.06.2024
3. Abstract submission: 09.06.2024
4. Acceptance Notification: 11.06.2024
5. Final Program announcement: 19.06.2024
6. Conference: 19-21.06.2024

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 09.06.2024. The abstract should be 150 – 300 words and it must contain the title, authors, and their full affiliation.

Scientific Committee

Acad. Maria ZAHARESCU, Romanian Academy (Romania)
Prof. Ecaterina ANDRONESCU, UPB&AOSR (Romania)
Dr. Vladimir BAULIN, URV (Spain)
Prof. Aldo R. BOCCACCINI, FAU (Germany)
Prof. Luigi CALABRESE, UniME (Italy)
Prof. Joan CERDÀ, UIB (Spain)
Prof. Carmen CHIFIRIUC, UniBuc (Romania)
Prof. Eduard COROPCEANU, UST (Moldova)
Prof. Ioana DEMETRESCU, UPB&AOSR (Romania)
Prof. Anton FICAI, UPB&AOSR (Romania)
Dr. Victor FRUTH-OPRIȘAN, ICF (Romania)
Prof. Maria GAVRILESCU, TU Iași&AOSR (Romania)
Prof. Oguzhan GUNDUZ, Marmara Univ (Turkey)
Prof. Domenico LOMBARDO, CNR-IPCF Messina (Italy)
Prof. Herbert Ryan MARINI, UNIME (Italy)
Prof. Carlos MARQUES, UniStra (France)
Prof. Lluis MARSAL, URV (Spain)
Prof. Viorel NACU, USMF (Moldova)
Prof. Ion NEDA, TU Braunschweig (Germany)
Prof. Faik OKTAR, Marmara Univ (Turkey)
Dr. Jörg OPITZ, IKTS (Germany)
Prof. Lenuța PROFIRE, UMF Iasi (Romania)
Prof. Marco RAGAZZI, Univ Trento (Italy)
Prof. Serguei SAVILOV, MSU (Russia)
Prof. Ze Xiang SHEN, NTU (Singapore)

Organizing Committee

Prof. Ecaterina ANDRONESCU – president
Prof. Maria GAVRILESCU
Prof. Oguzhan GUNDUZ
Prof. Anton FICAI
Dr. Angela SPOIALĂ
Dr. Alexa-Maria CROITORU
Dr. Georgiana NICOLAE
PhD Student Cornelia-Ioana ILIE
PhD Student Alexandra BURDUSEL
MSc Ioana SURDU
BSc Student Ibrahim Umut USTUNDAG

Program (GMT +2, Bucharest time)

Wednesday, 19 June 2024		
08:00 - 08:30		
08:30 - 09:00		
09:00 - 09:30		
09:30 - 10:00	**Registration**	
10:00 - 10:15	**OPENING CEREMONY** **Chair: Ecaterina ANDRONESCU** **link**	
10:15 - 10:30	**SESSION I. Circular Economy** **Chairs: Fatima MONTEMOR; Anton FICAI** **link** *Materials for high power electrochemical energy storage: from fit for the purpose design to creative reuse*. **Fátima MONTEMOR**	
10:30 - 10:45		
10:45 - 11:00	*The integration of circular economy principles into nanosciences and biomaterials engineering.* ***Walter R. STAHEL***	
11:00 - 11:15		
11:15 - 11:30	*Circular Economy: from education to innovative research on plastic waste*. **Elena-Cristina RADA**	
11:30 - 11:45		
11:45 - 12:00	*New sustainable processes for recycling REEs from End-of-Life magnets.* **Zara CHERKEZOVA-ZHELEVA**, Radu-Robert PITICESCU, Marian BURADA, Sabina Andreea FIRONDA, Daniela PANEVA, Anca Elena SOBETKII, Olivier JAY	
12:00 - 12:30	*Solar to steam generation for environmental & energy application.* **Ridha DJELLABI**	
12:30 - 13:00	**Oral Presentations**	
13:00 - 13:30	**LUNCH BREAK**	
13:30 - 14:00		
14:00 - 14:30	**SESSION II. Materials, Technologies and Devices in the Context of Circular Economy** **Chairs: Walter R. STAHEL; Simina LAKATOS** **link**	**SESSION III. TISSUE ENGINEERING AND REGENERATIVE MEDICINE** **Chairs: Stephen HILTON; Ovidiu OPREA** **link**
14:30 - 18:00		
15:00 - 15:30		
15:30 - 16:00		
16:00 - 16:30		
16:30 - 17:00	*When Technological Innovations Converge: The Rise of 3D Printing, VR, and AI in Elevating Synthesis and Remote Collaboration.* **Stephen HILTON**	
17:00 - 17:30	*From electrically conductive MOFs to sustainable batteries.* **Mircea DINCA**	

Thursday, 20 June 2024		
	SESSION IV. FOOD SAFETY AND NATURAL COMPOUNDS FOR HEALTH **Chairs: Elena-Cristina RADA; Nastasia BELC** **link**	**SESSION V. MATERIALS FOR ANTI-CORROSIVE AND ENVIRONMENTAL APPLICATIONS** **Chairs: Canan DOGAN; Maria GAVRILESCU** **link**
10:00 - 10:30	*EU4Health grants.* Maria VASILE	
10:30 - 11:00	*The EU Food Safety Platform: which opportunities for Youngs acting for the future of Food Safety in EU?* **Veronica MT LATTANZIO**, Nunzia M CITO, Antonio MORETTI, Nastasia BELC	
11:00 - 11:30 11:30 - 12:00 12:00 - 12:30 12:30 - 13:00	Oral Presentations	Oral Presentations
13:00 - 13:30 13:30 - 14:00	**LUNCH BREAK**	
14:00 - 14:30 14:30 - 18:00 15:00 - 15:30 15:30 - 16:00 16:00 - 16:30 16:30 – 16:45	**SESSION VI. MATERIALS WITH ANTIOXIDANT, ANTIMICROBIAL, AND ANTICANCER PROPERTIES (I)** **Chairs: Viorel NACU; Lenuta PROFIRE** **link**	**SESSION VII. ADVANCED MATERIAL FOR SPECIFIC APPLICATIONS** **Chairs: Ana ALCUDIA CRUZ; Ioana DEMETRESCU** **link**
16:45 - 18:00	**Poster SESSION** **Chairs: Cem Bulent USTUNDAG, Denisa FICAI, Irina FIERASCU, Vasile-Adrian SURDU**	

Friday, 21 June 2023		
10:00 - 10:30 10:30 - 11:00 11:00 - 11:30 11:30 - 12:00	**SESSION VIII. MATERIALS WITH ANTIOXIDANT, ANTIMICROBIAL, AND ANTICANCER PROPERTIES (II)** **Chairs: Jörg OPITZ; Radu FIERASCU** **link**	**SESSION IX. NATURAL, GREEN AND BIOMIMETIC MATERIALS** **Chairs: Veronica LATTANZIO; Danuţ-Ionel VĂIREANU** **link**
12:00 - 12:20	*Ultra-Slippery Wetting-Repellent Aerophilic Surfaces*. **Alexander B. Tesler**, et al.	
12:20 - 12:40	*Enhancing bioactivity of nanostructured TiO_2: interplay of morphology and surface chemistry*. **Anca Mazare**	
12:40 - 13:00	**CLOSING CEREMONY** **Chair: Ecaterina ANDRONESCU**	

Wednesday, 19 June 2024

09:30-10:00 – Registration

10:00-10:15 – OPENING CEREMONY - link

Chair: Ecaterina ANDRONESCU

Ecaterina ANDRONESCU – President of the Scientific Committee

Bogdan-Gruia IVAN - Minister of Research, Innovation and Digitization

Laszlo BORBELY - Head of the Sustainable Development Department, State Councilor

Tudor PRISECARU – President of the Senate of The National University of Science and Technology POLITEHNICA Bucharest

10:15-13:10 –SESSION I. Circular Economy - link

Chairs: Fatima MONTEMOR; Anton FICAI

10:15-10:45 Materials for high power electrochemical energy storage: from fit for the purpose design to creative reuse. **Fátima MONTEMOR**

10:45-11:15 The integration of circular economy principles into nanosciences and biomaterials engineering. **Walter R STAHEL**

11:15-11:45 Circular Economy: from education to innovative research on plastic waste. **Elena-Cristina RADA**

11:45-12:05 New sustainable processes for recycling REEs from End-of-Life magnets. Zara CHERKEZOVA-ZHELEVA, **Radu-Robert PITICESCU**, Marian BURADA, Sabina Andreea FIRONDA, Daniela PANEVA, Anca Elena SOBETKII, Olivier JAY

12.05-12:25 Solar to steam generation for environmental & energy application. **Ridha DJELLABI**

12:25-12.40 Complex 3D printed architectures for skin tissue repair and regeneration. **Isabella Nacu**, Andrei Tunaru, Ioana Ilie, Loredana Elena Nita, Liliana Verestiuc

12:40-12:55 Investigation of the effect of maleic anhydride grafted polyethylene compatibilizing agent in industrial lime sludge waste filled HDPE composites. **Satadru Kashyap**

13:00-14:00 – LUNCH BREAK

14:00 - 17:15 – SESSION II. Materials, Technologies and Devices in the Context of Circular Economy - link

Chairs: Walter R STAHEL; Simina LAKATOS

14:00-14:15 The Role of 3D-Printing Technologies in Oncology - A Comprehensive Study Among Medical Students. **Eugeniu Valic**, Vladimir Valic, Daniela Ciobanu, Ion Mereuță, Grzegorz Bieleda

14:15-14:30 NiCrAlY layers performance assessment developed onto 310H alloy by EB-PVD method after oxidation in aggressive conditions. **Aurelia Elena Tudose**, Ioana Demetrescu, Florentina Golgovici, Manuela Fulger, Diana Diniasi, Robert Radu Piticescu

14:30-14:45 TiO_2/Fe_2O_3 heterostructures for photocatalytic degradation of Reactive Yellow 176. **Maria Grapin**, Valentin Raditoiu, Alina Raditoiu and Florentina Monica Raduly

14:45-15:00 Efficient removal of anionic dye and pharmaceutical drugs from wastewaters by copper-modified hemp fibers. **Gianluca Viscusi**, Elena Lamberti, Giuliana Gorrasi

15:00-15:15 New polymer-modified Ti-alloy with potential application as stent in coronary surgery. **Stefan Sandu**, Doina-Margareta Gordin, Denis Laillé, Sandrine Geffroy, Vera Balan, Liliana Verestiuc

15:15-15:30 Some Aspects in the Evaluation of Biomaterials based on Collagen from the Umbilico-Placentary Complex. **Jian Mariana**, Mostovei Andrei, Solomon Oleg, Motelica Ludmila, Oprea Ovidiu Cristian, Cobzac Vitalie, Nacu Ana - Maria, Anton Ficai, Nacu Viorel

15:30-15:45 3D-Printed Scaffolds for Osteoporotic Bone Restoration based on Poly-ε-Caprolactone and Strontium-Doped Hydroxyapatite. **Cosmin Iulian Codrea**, Daniel Lincu, Irina Atkinson, Alexa Maria Croitoru, Bogdan Stefan Vasile, Adrian Ionut, Nicoară, Vladimir Lucian Ene, Miruna Silvia Stan, and Anton Ficai

15:45-16:00 Synthesis and Development of Perovskite Materials for Advance Energy Generation. **Muhammad Salman Habib**, Muhammad Asif Rafiq

16:00-16:15 Development and characterization of MOF-silane composite coatings for adsorption heat pump application. **Muhtadi Idrees**, Antonio Fotia, Emanuela Mastronardo, Luigi Calabrese

16:15-16:45 When Technological Innovations Converge: The Rise of 3D Printing, VR, and AI in Elevating Synthesis and Remote Collaboration. **Stephen HILTON**

16:45-17:15 From electrically conductive MOFs to sustainable batteries. **Mircea DINCA**

14:00 - 16:00 – SESSION III. TISSUE ENGINEERING AND REGENERATIVE MEDICINE - link

Chairs: Stephen HILTON; Ovidiu OPREA

14:00-14:15 Potential application of PVA based electro spun nanofiber mates. **Karanjit Kapila**, Sushen Kirtania

14:15-14:30 YSZ-based scaffolds infiltration with nanohydroxiapatite and silver nanoparticles biopolymeric composites for bone regeneration applications. **Ernesto J. Delgado-Pujol**, Gemma Fargas, Victoria Axelra, Guillermo Martinez, Gemma Herranz, Belén Begines, Cristina Berges, Luis Llanes, Ana Alcudia, Yadir Torres

14:30-14:45 Novel biodegradable hydrogels for biomedical applications. **Guillermo Martínez Muñoz**, Ernesto Delgado-Pujol, Belén Begines Ruiz, David Casado Jurado, Ana Alcudia Cruz, Yadir Torres

14:45-15:00 Polymer Based Dental Membrane. **Hilal Gülsena Nur Akkuş**, Cem Bülent Üstündağ, Azime Erarslan1, Israa F. Abdulazez, Ayşe Betul Bingöl, Buşra Oktay

15:00-15:15 Biocompatible and Conductive Cardiac Patches: Electrospun PCL-Reduced Graphene Oxide-Collagen-Gelatin Composites for Tissue Regeneration. **Israa F. Abdulazez**, Buşra Oktay, Ayşe Betül Bingöl, Cem Bülent Üstündağ

15:15-15:30 Decellularized algae as complex structures for skin tissue engineering. **Andreea Luca**, Maria Stella Pascal, Teodora Vlad, Florina Daniela Cojocaru, Maria Butnaru, Liliana Vereștiuc

15:30-15:45 Advancements in injectable biocements: the role of gellan hydrogel in magnesium phosphate bone cement. **Maryia Khamenka**, Anna Ronowska, Aleksandra Mielewczyk-Gryń, Dawid Kozień; Justyna Kozłowska, Marcin Wekwejt

Thursday, 20 June 2024

10:00 - 13:00 – SESSION IV. Food Safety and Natural Compounds for Health - link

Chairs: Elena-Cristina RADA; Nastasia BELC

10:00-10:30 EU4Health grants. Maria VASILE

10:30-11:00 The EU Food Safety Platform: which opportunities for Youngs acting for the future of Food Safety in EU? Veronica MT LATTANZIO, Nunzia M CITO, Antonio MORETTI, Nastasia BELC

11:00-11:15 Biopolymer-Based Food Packaging: Techniques for Incorporating Functional Ingredients and Enhancing Food Quality. **Pir Mohammad Junaid**, Sadaf Zaidi

11:15-11:30 Catechols: A Never-Ending Story of Building Innovative Polymeric Materials. **Alin-Ionuț Alecu**, Ana-Maria Albu, Celina Maria Damian, Andra Mihaela Onaș, Cristina Stavarache, Roxana Trușcă

11:30-11:45 Synthesis and Characterization of Propolis Loaded Microspheres and Investigation of Health Effects. **Busra Sinan,** Elif Ilhan, Oguzhan Gunduz, Adviye Gulcin Sagdıcoglu Celep

11:45-12:00 Analysis of oxycodone hydrochloride as an opioid analgesic. **Creangă Elena Christen**

12:00-12:15 Potential applications of cellulose-acetate based polymeric membranes. **Ananda Ram Barman**, Polash Protim Dutta, Karanjit Kapila

12:15-12:30 Curcumin and Licodine Hydrochloride USP Monohydrate-Loaded Dressing for Treatment of Moderate Burns. **Kardelen Gürbüz**, İlknur Daniş, Melike Atasoy, Ayşe Betül Bingöl, Büşra Oktay, Cem Bülent Üstündağ

12:30-12:45 Harnessing the Nature: Applications of Essential Oils in various fields. **Sunita Singh**, Avanish Chandra Sharma

11:00 - 13:00 – SESSION V. MATERIALS FOR ANTI-CORROSIVE AND ENVIRONMENTAL APPLICATIONS - link

Chairs: Canan DOGAN; Maria GAVRILESCU

11:00-11:15 The influence of temperature on the structure and properties of TiZrTaAg high entropy alloy. **Radu Nartita**, Andrei Bogdan Stoian, Daniela Ionita, Ioana Demetrescu

11:15-11:30 Utilizing Cassia Occidentalis as a Natural Reducing and Stabilizing Agent for Titanium Oxide Nanoparticles in Photocatalytic Applications. **Abubakar Dantani Meli**, Mohamed Abdelmonem, Che Azurahanim Che Abdullah

11:30-11:45 Tailored Electrophoretic Coatings for Enhanced Corrosion Resistance of 316L Stainless Steel Implants using Bioactive Glasses. **Salwa El Baakili**, Abdelhabib Semlali, Hawraa Issa, Meriame Bricha, Khalil El Mabrouk

11:45-12:00 Synthesis and Characterization of Iron Oxide Nanoparticles for Sustainable and Efficient Water Purification**. Nayab Raza**, Aneela Anwar, Mariam Sohail Mansoor, Furqana Bibi

12:00-12:15 Exploring Lantana camara essential oil as a green corrosion inhibitor for carbon steel in acidic environments. **Khaoula Mzioud,** Souad El Fartah, Amar Habsaoui, Sara Rached, Kharbouch Otmane, Ebn Touhami Mohamed

13:00-14:00 – LUNCH BREAK

14:00 - 16:45 – SESSION VI. MATERIALS WITH ANTIOXIDANT, ANTIMICROBIAL, AND ANTICANCER PROPERTIES (I) - link

Chairs: Viorel NACU; Lenuta PROFIRE

14:00-14:15 Antimicrobial and biodegradable electrospun nanofiber composite for wound dressing. **Abdul Bari Yaqub**, Musa Ayran, Elif Kaya, Aysegul Tiryaki, Songul Ulag, Gulgun Bosgelmez Tinaz, Oguzhan Gunduz

14:15-14:30 Fabrication of ethosuximide loaded pcl/bfo based three-dimensional tissue scaffolds and controlled drug release in electric field for the treatment of epilepsy. **Aysim Akyol**, Esra Ozdemir, Hatice Karabulut, Songul Ulag, Zehra Kanli, Banu Aydin, Oguzhan Gunduz

14:30-14:45 Complex polymeric matrices with antibacterial and antioxidant inclusions. **Bianca-Elena-Beatrice Cretu**, Gianina Dodi, Ioannis Gardikiotis, Vera Balan, Alina Gabriela Rusu, Alina Ghilan, Loredana Elena Nita, Aurica P. Chiriac

14:45-15:00 Characterization and Antibacterial Activity of Zinc Oxide Nanoparticles Synthesized via Non-Thermal Plasma Process. **Bounedjar Nourelhouda**, Ferhat Mohammed Fouad, Toukal Linda, Anton Ficai

15:00-15:15 Design and Characterization of a Wound Dressing Using Beta-Glucan and Zinc Oxide Nanoparticles via Electrospinning Method. **Derya Çelik**, Yunus Emre KUL. Cem Bülent Üstündağ

15:15-15:30 Development Of Nanobody-Conjugated Polyethyleneimine Polymeric Nanoparticles For Targeted Therapy. **Dilara Zalim**, Rabia Çakır, Lara González-Cabaleiro, Lorena Vázquez-Iglesias, Isabel Pastoriza-Santos, Gustavo Bodelón

15:30-15:45 Hyaluronic acid/ellagic acid as materials for potential medical application. **Sylwia Grabska-Zielińska**, Beata Kaczmarek-Szczepańska, Konrad Kleszczyński, Lidia Zasada, Dorota Chmielniak, Mara Barbara Hollerung, Katarzyna Dembińska, Krystyna Pałubicka, Kerstin Steinbrink, Maria Swiontek-Brzezinska

15:45-16:00 The Integration of PVA Hydrogel with Magnesium Phosphate – development of biocement for Advanced Medical Applications. **Magdalena Górecka**, Anna Ronowska, Aleksandra Mielewczyk-Gryń, Dawid Kozień, Justyna Kozłowska, Marcin Wekwejt

16:00-16:15 Temperature-responsive N-isopropylacrylamide (NIPAm) and gelatin methacryloyl (GelMA)-based hydrogels for controlled drug delivery. **Maria Daaboul,** Ayse Akkaya, Oguzhan Gunduz, Emine Alarcin, Mehmet Murat Ozmen, Murat Topuzogullari

16:15-16:30 Gelatin methacryloyl (GELMA) microneedles for localized delivery of antiepileptic drugs loaded on bismuth ferrite (BFO) and polylactic-co-glycolic acid (PLGA) particles. **Yeliz Guldorum**, Sule Ilgar, Zekiye Akdag, Esra Pilavci, Songul Ulag, Emine Alarcin, Ayse Akkaya, Banu Aydin Omay, Zehra Kanli, Oguzhan Gunduz

16:30-16:45 Variation of the antioxidant effect of the volatile oil obtained from Achillea millefolium depending on the geographical area. **Bogdan Purcăreanu**, Diana Manuela Ene, Veronica Drumea, Dan Eduard Mihaiescu, Anton Ficai

14:00 - 16:45 – SESSION VII. ADVANCED MATERIAL FOR SPECIFIC APPLICATIONS

Chairs: Ana ALCUDIA CRUZ; Ioana DEMETRESCU link

14:00-14:15 Polyaniline-based room temperature methane gas sensor. **Ana-Maria Popa**, Andrei Stochioiu, Luiza-Izabela Toderașcu, Vlad-Andrei Antohe, Gabriel Socol and Iulia Antohe

14:15-14:30 Fire Reaction Performance of Nanosilica-Treated Wood: A Study of Various Fire Testing Methods. **Diana Floriana Talau**, Anton Ficai

14:30-14:45 Application of response surface methodology (RSM) for optimization of synthesis parameters of rGO@MnO_2 nanocomposites as electrode materials for asymmetric supercapacitor device. Balarabe El-Yaqub, **Mohd Haniff Wahid**, Abdul Halim Abdullah, Wan Azlina Wan Ab Karim Ghani

14:45-15:00 The Enhancement of Hydroxyapatite's Inhibitory Properties of Steel Through a Grafting Reaction with Phenolic Compounds in NaCl 3%. **Nouhaila Ferraa**, Mzioud Khaoula, Moussa Ouakki, Mohammed Cherkaoui, Mounia Bennani Ziatni

15:00-15:15 Macromolecular chemistry versatile tool for improving the self-assembly skills of commercial coatings. **Paul Valentin LOVIN**, Ana Maria Albu, Iulia Neblea, Ioana Cătălina Gîfu, Bogdan Trica, Cristian Andy Nicolae

15:15-15:30 Assessing the effect of pH and immersion time on ZnO-based thin films synthesized via automated SILAR process for gas sensor applications. **Ismail Haijoub**, Brahim Ydir, Mouad Soumane, Nejma Fazouan, El Houssine Atmani, Houda Lahlou, Radouane Leghrib

15:30-15:45 Comparative effect of unmodified and surface-modified nanocellulose on the characteristics of nanoemulsions. **Gabriela - Mădălina Oprică**, Cătălina - Diana Ușurelu, Adriana Nicoleta Frone, Cristina Firincă, Cristian - Andi Nicolae, Radu Claudiu Fierăscu, Denis Mihaela Panaitescu

15:45-16:00 Nanotechnology Based Medical Devices: Potentialities, Risk and Regulation. **Rupak Kumar**

16:00-16:15 Fabrication and characterization of zinc oxide (ZnO) thin films deposited by sol-gel dip coating process. **Oloruntoba Sola Omodele**, Zulkarnain Zainal, Yusran Sulaiman, Ruzniza Mohd Zawawi

16:15-16:30 Analyzing the Conductivity and Dielectric properties of carbon nanofibres reinforced polyvinylidene fluoride composite films. **Yassine Nioua**, V. M. Serrato, A. Triki, A. J. Paleo, Z. Samir, N. Aribou, M. Hdidar, M. Arous, K. Lozano and M. E. Achour

16:30-16:45 Analyzing the Conductivity and Dielectric properties of carbon nanofibres reinforced polyvinylidene fluoride composite films. **Yassine Nioua**, V. M. Serrato, A. Triki, A. J. Paleo, Z. Samir, N. Aribou, M. Hdidar, M. Arous, K. Lozano and M. E. Achour

16:45 - 18:00 – Poster SESSION

Chairs: Chairs – Cem Bulent USTUNDAG, Denisa FICAI, Irina FIERASCU, Vasile-Adrian SURDU

1 Strategies to obtain PVA alignment layers for nematic liquid crystals used in biosensing. **Cristina-Delia Nechifor**, Marian Lutcanu, Alexandra Tamara Sutic

2 Pigment Based Composites with Polyolefin Matrix and Surface Modified Aramid Fibers. **Cristina-Elisabeta Pelin**, Maria Sonmez, George Pelin, Adriana Ştefan, Maria Daniela Stelescu, Mihai Georgescu

3 Alginate-pullulan composites as candidates for skin wound healing applications. **Emma Bobu**, Klara Magyari, Monica Baia

4 Biopolymer Composite Supports, a New Perspective in the Medical Field. **Elena Berteanu**, Iordachel Catalin, Maria Paraschiv, Manoiu Sorin, Andreea Iosageanu, Enache Mihaela Ionica, Alexandrina Rugina, Adina-Lidia Zuav

5 Development of New Biodegredable Polymers for Selected Biomedical Applications. **Hend Behour**, Sherif Kandil, Labiba El-khardagui

6 Structural, optical and electrical properties of spray deposited Sr doped SnO2 thin films. **Imene Saoula**, Chahinez Siad, Nassiba Allag, Nourelhouda Bounedjar

7 The Effect of Extracts Obtained from Viticulture Wastes on the Grapevines Maturity Degree. **Ionela-D. Toma (Sărdărescu),** Diana E. Vizitiu, Irina Fierăscu, Anda M. Baroi, Alin Din, Radu C. Fierăscu

8 Bone Tissue Engineering Scaffolds Based on Pure and Zn Doped Merwinite Obtained by 3D Printing. **Maria-Eliza Puşcaşu,** Florentina-Gabriela Ioniță, Cristina Busuioc

9 Impact of the glucose metabolism disorders on the indicators of oxidative stress in patients with pulmonary tuberculosis. **Lesnic Evelina**, Igor Semianiv, Malic Alina

10 Antimicrobial composite packaging films. **Gabriela Petrisor**, Ludmila Motelica, Denisa Ficai, Ovidiu Oprea, Anton Ficai, Trusca Roxana, Ecaterina Andronescu, Alina Holban

11 Characterization and synthesis of 45S5 bioactive glass via the sol-gel method. **Marian Raşcov**, Anton Ficai, Ovidiu Cristian Oprea, Otilia-Ruxandra Vasile, Roxana Doina Trușcă, Ecaterina Andronescu

Cerium
Adrian-

12 Development of nanocomposites based on recycled high-density polyethylene and organically modified montmorillonite. **Maria Daniela Stelescu**, Ovidiu Cristian Oprea, Doina Constantinescu, Maria Sonmez, Mihai Georgescu, Ludmila Motelica, Denisa Ficai, Dana Florentina Gurau

13 NMR study of cinnamaldehyde thiosemicarbazones derivatives with biological potential. **Rusnac Roman**, Ciursin Andrei, Gulea Aurelian

14 Effect of egg white in biogenic elaboration of ZnO. **Adriana-Gabriela Schiopu**, Elena Andreea Vijan

15 Synthesis and Characterization of Polymeric Membranes Enhanced with Hydrothermally Activated Titanium Dioxide Nanoparticles. **Simona Căprărescu**, Roxana Gabriela Zgârian, Graţiela Teodora Tihan, Alexandru Mihai Grumezescu

16 Integration of Sol-Gel Synthesis and Additive Manufacturing Techniques for fabrication of walstromite-based scaffolds. **Ștefania Chiriac (Caramarin)**, Mihnea Pele, Georgeta Voicu, Roxana Popescu, Andreia Cucuruz, Cristina-Daniela Ghițulică, Izabela-Cristina Stancu, Lucian-Toma Ciocan, Ruxandra-Elena Geanaliu-Nicolae

17 Preparation, characterization and mechanical testing of PMMA/TiO_2 film nanocomposite. **Yasmina Khane**, Zoulikha Hafsi, Abdelhalim Zoukel

18 Developing Chemically Modified Collagen Bone Graft Materials for Use in 3D Bioprinted Scaffolds. Zehra Betül Ahi, **Mihriban Aydoğan-Gemici**, Beyza Çay

19 Ultrasound-assisted synthesis of Silver@Chitosan nanocomposites and its photocatalytic activity. **Harekrishna Mahato**, Brajesh Kumar

20 Smart graphene oxide-based hydrogels with photothermal effect for wound healing applications. **Alexa-Maria Croitoru**, Anton Ficai, Roxana Trusca, Ludmila Motelica, Bianca-Maria Tihauan

21 A Comparative Investigation of the Size-Strain Plot, Williamson-Hall, and Halder-Wagner X-Ray Diffraction Analytical Methods of MnO_2-GO Nanoparticles. **Balarabe El-Yaqub**, Mohd Haniff Wahid, Zulkarnain Zainal, Abdul Halim Abdullah, Wan Azlina Wan Ab Karim Ghani

Friday, 21 June 2023

10:00 - 13:00 – SESSION VIII. MATERIALS WITH ANTIOXIDANT, ANTIMICROBIAL, AND ANTICANCER PROPERTIES (II) - link

Chairs: Jorg OPITZ; Radu FIERASCU

10:00-10:15 Synthesis, characterization and In-vitro investigation of the activity of Doxorubicin-loaded PLA-based nanofibers. **Natavan Ismayilova**, Songul Ulag, Ali Sahin, Firat Baris Barlas, Erol Ince, Oguzhan Gunduz

10:15-10:30 Development of hydroxyapatite-based drug delivery devices loaded with doxorubicin for the treatment of breast cancer. **Reyhan Yanıkoğlu**, Sahar Dinparvar, Adil Allahverdiyev, Cem Bülent Üstündağ

10:30-10:45 Carbon Nanomaterial Based Drug Delivery Systems and Applications. **Reyhan Yanıkoğlu**, Cem Bülent Üstündağ

10:45-11:00 *Docetaxel-Loaded Polymer Coated Iron Oxide Nanoparticles Intended for Prostate Cancer Treatment. **Romesa Soomro**, Che Azurahanim Che Abdullah*

11:00-11:15 *Development and Characterization of Biomaterials Using Electrospinning Method. **Sude Göktuğ**, Tubanur Avcı, Canan Doğan, Oğuzhan Gündüz*

11:15-11:30 *Production of Nanofibers by Coaxial Electrospinnig Method Using Bacterial Cellulose Synthesized Using Orange Peel Extract and PCL/PLA Composite. **Aysenur Avcı**, Melike Naz Sayan, Rabia Betul Sulutas, Aslıhan Calhan, Sumeyye Cesur, Oguzhan Gunduz, Cem Bülent Üstündağ*

11:30-11:45 Development and Characterization of Biomaterials by Adding Henna Using Electrospinning Method. **Tubanur Avcı**, Emre Uygur, Canan Doğan,Oğuzhan Gündüz

11:45-12:00 Production of Biomaterial with Controlled Drug Release System Developed with Hybrid System for Laryngeal Cancer Treatment. **Yaren Inal**, Sude Toptas, Yagmur Kazancıoglu, Fatma Ozdemir

12:00-12:20 Ultra-Slippery Wetting-Repellent Aerophilic Surfaces. **Alexander B. Tesler**, et al.

12:20-12:40 Enhancing bioactivity of nanostructured TiO_2: interplay of morphology and surface chemistry. **Anca Mazare**

10:00 - 13:00 – SESSION IX. Natural, Green and Biomimetic Materials - link

Chairs: Veronica LATTANZIO; Danut-Ionel VAIREANU

10:00-10:15 Antibacterian and anticancer effects of cyanobacteria Calothrix marcica. **Alina Trofim,** Greta Balan and Valeriu Rudic

10:15-10:30 New biotechnologies for purification of phycobiliproteins with antibacterial and antifungal effect. **Alina Trofim**, Angela Rudacova

10:30-10:45 The in vivo Effects of Indigenous Biologically Active Compounds on Liver Biochemical Markers in Blood Plasma of Rats. **Valeriana Pantea**, Cristina Popușoi, Marina Reabîșeva, Mariana Jian, Ecaterina Pavlovschi, Inna Șveț, Oxana Nicolaeva, Veaceslav Popa

10:45-11:00 Green route Concoction and Characterization of MgO Nanoparticles and Guesstimate of their Antimicrobial Activity. **Sambandam Thamizharasan**, Karuppasamy Gurunathan

11:00-11:15 Biogenically synthesized zinc oxide nanoparticles: A promising paradigm for effective therapy. **Devi-Nair Gunasegavan Rathi**, Norhaizan Mohd Esa and Che Azurahanim Che Abdullah

11:15-11:30 Slow Release Properties of Bioglass Impregnated with Essential Oils and Surfactants. **Ioana Lavinia Lixandru Matei**, Bogdan Alexandru Sava

11:30-11:45 Biological applications of bis-thiosemicarbazones with a cyclohexyl ring. Andrei Ciursin; Ion Bulimestru; Roman Rusnac

11:45-12:00 In Vitro Characterization and Evaluation of 3D-Printed Styrax Liquidus (Liquidambar orientalis Miller)-Loaded Poly(L-lactic acid)/Chitosan Based Wound Dressing Material. **Hanife Yuksel Cakmak**, Hasan Ege, Senanur Yilmaz, Gokhan Agturk, Fulya Dal Yontem, Gozde Enguven, Abdurrahman Sarmis, Zeren Cakmak, Oguzhan Gunduz, Zeynep Ruya Ege

12:40-13:00 – CLOSING CEREMONY - link

Chair: Ecaterina ANDRONESCU

Book of abstracts

Plenary Lectures

From electrically conductive MOFs to sustainable batteries

Mircea DINCĂ

Department of Chemistry
Massachusetts Institute of Technology
**E-Mail: mdinca@mit.edu*

ABSTRACT

The emergence of electrically conductive metal-organic frameworks (MOFs) has been one of the most paradoxical developments in the field in the last few years. Indeed, how can one transport charges through a material that is mostly "empty" space? In this sense, MOFs made from layers of organic ligands connected by (typically) square-planar metal ions have shown particularly good electrical conductivity. However, a precise mechanism for charge transport is still the subject of debate, with various experimental and computational reports describing these materials as metals, semiconductors, semimetals, or even borderline insulators. Most of the discussion on this point has been focused on the effects of in-plane metal-ligand conjugation and the efficiency of in-plane transport. This lecture will describe the latest efforts from our group to understand the intrinsic properties of these materials, especially as related to single-crystal electrical measurement studies, and will discuss in particular the unexpectedly large influence of out-of-plane transport. Time allowing, I will discuss unexpected results stemming from the behavior of these materials as 1D metals, and applications in energy storage and conversion.

When Technological Innovations Converge: The Rise of 3D Printing, VR, and AI in Elevating Synthesis and Remote Collaboration

Stephen Hilton

University College London; UCL School of Pharmacy; Room 406 29-39 Brunswick Square; London, United Kindom

ABSTRACT

In this talk we will describe our research into 3D printing with embedded catalysts for batch chemistry, the development and commercialisation of continuous flow reactors as well as more recent work covering the production of low-cost syringe pumps, fraction collectors and continuous flow photochemistry systems. As part of our transition into the digitisation of continuous flow chemistry, we will also discuss the creation of a unique Virtual Reality training environment for continuous flow chemistry as well as the integration of real time telemetry into this medium for global collaboration. As part of our digitisation approach, we will also describe our integration of AI conversation based avatars that are able to help chemists improve their continuous flow set-ups and to provide laboratory advice 24/7 for researchers in our new digital flow chemistry institute.

The EU Food Safety Platform: which opportunities for Youngs acting for the future of Food Safety in EU?

Veronica MT Lattanzio[1,*], Nunzia M Cito, Antonio Moretti[1], Nastasia Belc[2]

[1] National Research Council of Italy, Institute of Sciences of Food Productions, 70126, Bari, Italy
[2] National Institute of Research&Development for Food Bioresources, 060042 Bucharest, Romania
[*]Correspondence: veronicamariateresa.lattanzio@cnr.it

ABSTRACT

The in-depth analysis of the evolving EU Food Safety scenario, carried out within the FoodSafety4EU project (www.foodsafety4.eu), showed that the mission of the next generation of food safety experts and risk assessors/communicators will be to set the scene, define the borders in which sustainable food systems will evolve. Keeping the focus on food safety in the food system transformations implies widening the EU food risk analysis capacity, and, in turn, acquiring/fostering the necessary skills to:

- unravel the food safety challenges (re)-ememering from technological innovations and circular economy,
- get insights from social research to address consumers' concerns and expectations,
- support regulatory science and the science-based decision making for food safety policies.

Due to the complexity of underlying science, besides acquiring transdisciplinary expertise, intensifying knowledge exchanges and cooperation between food safety system actors has become a key prerequisite to deliver future-proof solutions. However, engaging with stakeholders having diverse backgrounds and priorities, then making sure to bring into the dialogue multiple perspectives, requires putting place and piloting appropriate methodologies.

To this scope, the FoodSafety4EU project established a new permanent, multi-stakeholder, collaborative platform: the EU Food Safety Platform.Whether they are scientists, students, entrepreneurs, policy advisors, food business operators or a communication experts, the EU Food Safety Plaform offers to youngs a collaborative space for dialogue, co-creation, mutual learning, and experimentation to provide a holistic experience on what's going on in food safety and as well as envisage career perspectives for the future.

Over the last 3 years youngs passionate about food safety were actively engaged in the platform by

- designing or attending training on science communication
- developing and piloting new communcation models
- joining high level experts in the co-creation of a Strategic Research and Innovation Agenda
- leading working groups
- designing and leading the Youngs' session at the EU Food Safety Forum

The outcomes of these activities and how they set the basis for future developments will be discussed.

Acknowledgments: This project has received funding form the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000613

Materials for high power electrochemical energy storage: from fit for the purpose design to creative reuse

Fátima MONTEMOR

Centro de Química Estrutural, Institute of Molecular Sciences

Departamento de Engenharia Química, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1049 001 Lisboa, Portugal

ABSTRACT

Electrochemical energy storage is at the core of the energy transition, and the scientific community is being called upon to contribute to the development of new and more sustainable energy storage solutions. The current market is dominated by conventional carbon ultracapacitors (low energy-high power densities) and batteries (high energy-moderate power densities), particularly lithium-ion batteries. Between these two families of systems, there is a significant gap in terms of device metrics. To fill this gap, it is crucial to design new materials and combine them appropriately to fully explore their electrode potential. This strategy enables the development of hybrid or asymmetric electrochemical energy storage devices with tailored metrics that meet specific application requirements. Thus, the electrode materials play a pivotal role in defining the metrics of the energy storage device, and this research area paves the way to solving many bottlenecks in the electrochemical energy storage field.

This presentation overviews the latest advances in the design, production, and testing of electrode materials, including materials recycled from spent lithium-ion batteries, and their potential applications in a new generation of high-power electrochemical devices operating in environmentally friendly aqueous electrolytes. A comprehensive overview of the most promising materials and electrolytes will be given, and a set of selected examples will highlight how scale-up and commercialization can be achieved in this important field.

Acknowledgments: The author acknowledges the funding provided by Fundação para a Ciência e a Tecnologia through the Projects: DOI 10.54499/PTDC/QUI-ELT/2075/2020, DOI 10.54499/2022.05187.PTDC, DOI 10.54499/UIDP/00100/2020, DOI 10.54499/UIDP/00100/2020 and DOI 10.54499/LA/P/0056/2020 and PRR NGS Agenda

Circular Economy: from education to innovative research on plastic waste

Elena Cristina RADA

University of Insubria; Department of Theoretical and Applied Sciences, via G.B. Vico, 46 – Varese, Italy, I – 21100; Correspondence: elena.rada@uninsubria.it

ABSTRACT

In the last millenium, after the Millenium Development Goals (MDGs), Circular Economy (CE) became one of the most relevant visions to follow and implement in order to fight the environmental pollution and the loose of primary resources. Even if the concept of CE is not new, being used since 1947 connected with the industrial symbiosis, only since 2015 specific norms on CE were developed at European level [1].

In order to achieve the implementaion of the CE concepts in the countries of the European Union (EU) the environmental education and communication to all the citizens at all the ages must be put in the first place. EU helps for implementing this vision not only thanks to new regulations and norms on CE but also through the possibility to obain financing for the developemt of international projects with partners from EU countries. One of these projects is EDU4PlastiCircular, that aims to raise awareness and promote green practices regarding the use of plastics in a circular and climate-neutral economy, through innovative training methods in four EU countries [2].

Plastics represent one of the most perceived problems at all levels: citizens, reserchers, managers and politicians. All of them can discuss in order to propose solutions to decrease the plastic pollution on the world only if all of them have an environmental background. Thanks to projects like EDU4PlastiCircular, this is possible to be achived in many EU countries.

Italy, being one of the founders of the European Community, in 2014 issued an Enviornmental Guide that takes into account the CE and Sustainable Development Goals (SDGs) in the primary education system. Thanks to this guide, the CE concepts were introduced in disciplines like hystory, geography, science, technology, art and imaging all connected with different aspects of environmental management. This integration was made in respect of the environment hand in hand with the technological progress for closing the loop.

Italy is going ahead in the implementation of CE and environmental education at all levels. Thanks to this approach it was possible to go and develop innovative research on plastic waste. One of these relates to the project “ProPla – Protein from plastics” that aims to recover the microPET pollutant from wastewater plants and from drying and washing machines to convert it into a natural amino acid (L-alanine) or in high-value compounds (proteins, lipids, chitin) via insects appropriately "modified" [3].

Summing up, plastic waste gives an opportunity to involve different spheres of the society in a common effort for protecting our planet.

References:

1. Rada E.C., 2023. Circular Economy: Origins, Evolution and Role of MSW, Environmental and Climate Technologies, 27(1), pp. 989-998
2. https://microplastics.today
3. https://www.theproteinfactory2.it/propla-news

Acknowledgments: this work supported by: **ProPla** – 2022-0631 funded by Fondazione Cariplo at will on the Circular economy call: promoting research for a sustainable future and **EDU4PlastiCircular** –2023-1-RO01-KA220-HED-000166242, funded within ERASMUS+ Program.

The integration of circular economy principles into nanosciences and biomaterials engineering

Walter R. STAHEL[1,2,3]

[1] The Product-Life Institute, 9, chemin des Vignettes CH-1231 Conches, Geneva, Switzerland

[2] Faculty of Engineering and Physical Sciences, University of Surrey, Guildford, Surrey, GU2 7XH, UK

[3] Institut Environnement, Development Durable et Economie Circulaire (IEDDEC), Montréal, Canada

Correspondence: wrstahel2014@gmail.com

ABSTRACT

The integration of circular economy principles into the fields of nanosciences and biomaterials engineering is crucial for advancing sustainable development. Embedding these concepts into research and development can lead to innovative solutions that significantly improve sustainability. By focusing on the entire lifecycle of materials - from design to disposal - circular economy principles help minimize waste and maximize resource efficiency. Research and development in these fields can lead to innovations that reduce environmental impact and enhance material efficiency. For instance, nanomaterials designed for recyclability and biodegradability can replace traditional materials that are difficult to recycle and harmful to the environment. Case studies have shown that these integrations can lead to substantial sustainability improvements. For example, the development of nanoscale coatings that enhance the durability and recyclability of materials has reduced waste and extended product lifespans. Chemistry plays a pivotal role in designing materials that are both durable and recyclable. Integrating circular economy principles into nanosciences and biomaterials engineering, designing innovative and recyclable materials, and applying green chemistry practices are critical steps towards reducing environmental impact and promoting sustainability. These strategies not only enhance material efficiency and durability but also contribute to a more sustainable and resilient industrial ecosystem. By continuing to explore and implement these approaches, we can drive significant advancements in environmental sustainability and resource management.

KEYNOTES

Solar to Steam Generation for Environmental & Energy Application

Ridha DJELLABI

Departament d'Enginyeria Química, Universitat Rovira i Virgili, Av. Països Catalans, 26, 43007 Tarragona, Spain

Email: ridha.djellabi@urv.cat , ridha.djellabi@yahoo.com

ABSTRACT

Solar-to-steam generation (SSG) is emerging green technology which could be applied for many environmental and energy applications. The concept of solar photothermal water evaporators is based on the accelerated heating of the air–water interface (excluding bulk water) using floating materials that can effectively convert the solar light into heat. In this approach, the engineering of materials and systems are key determinants for enhanced photothermal conversion and water evaporation under daily solar light. In this talk, we will discuss the mechanisms SSG and controlling factors to boost the localization of heat and steam generation. The application of SSG for seawater desalination and H_2 generation will be addressed by showing case studies from our research activities. The importance of SSG configuration and used photothermal nanomaterials to solve common issues or/and to boost the performance will be stressed and clarified.

Keywords: Solar-to-steam generation; Solar desalination; H_2 generation; Energy transition; Circular economy.

Enhancing bioactivity of nanostructured TiO_2: interplay of morphology and surface chemistry

Anca MAZARE[1,*]

[1] Friedrich-Alexander University Erlangen-Nuremberg, Department of Materials Science WW4-LKO, 91058 Erlangen, Germany; *Correspondence: anca.mazare@fau.de

ABSTRACT

Enhancing bioactivity in biomaterials through advanced surface modification techniques is critical for successfully integrating implants within biological systems. Electrochemical anodization, which forms titanium dioxide (TiO_2) nanotubes (NTs) on titanium, is widely used for nanostructuring surfaces, showing improved biocompatibility and a significant effect of nanotopography [1–4].

Herein, surface functionalization approaches of the nanostructured layers to enhance hydroxyapatite (HA) formation will be shown. Functionalization strategies to enhance the osteoconductive properties of the tube layers are discussed, and selected examples based on an alternate immersion method (AIM) and a simpler immersion in calcium-containing solutions are shown [5]. The former pre-loads HA into the NTs, while the latter creates a calcium-enriched surface layer. These approaches are instrumental in promoting the nucleation and growth of HA, a mineral crucial to bone regeneration and integration. TiO_2 NTs with a tailored morphology were designed through anodization, and the obtained layers were grown in phosphate-based electrolytes, so with the incorporation of phosphate ions or phosphate-free electrolytes (i.e., without), thus emphasizing that the tube chemistry has a significant effect.

Our results indicate that large diameter NTs (e.g., 100 nm) upon such functionalization readily facilitate HA layer formation following immersion in simulated body fluid (SBF), a testament to the efficacy of phosphate pre-incorporation during anodization. Conversely, the surface nanotopography of smaller diameter NTs significantly influences HA nucleation, particularly evident with the AIM method, highlighting the importance of tailored nanoscale features for enhanced bioactivity.

The present work shows the potential of targeted surface modifications to significantly advance Ti-based implants' bioactivity and offers promising approaches for improving their biological performance and integration.

References

[1] K. Lee, A. Mazare, P. Schmuki, One-dimensional titanium dioxide nanomaterials: Nanotubes, Chem. Rev. 114 (2014) 9385–9454. https://doi.org/10.1021/cr500061m.

[2] J. Park, A. Cimpean, A.B. Tesler, A. Mazare, Anodic TiO_2 nanotubes: Tailoring osteoinduction via drug delivery, Nanomaterials. 11 (2021). https://doi.org/10.3390/nano11092359.

[3] A. Mazare, Comment on “old is Gold: Electrolyte Aging Influences the Topography, Chemistry, and Bioactivity of Anodized TiO_2 Nanopores,” ACS Appl. Mater. Interfaces. 14 (2022) 14837–14841. https://doi.org/10.1021/acsami.1c18860.

[4] J. Park, A.B. Tesler, E. Gongadze, A. Iglič, P. Schmuki, A. Mazare, Nanoscale Topography of Anodic TiO_2 Nanostructures Is Crucial for Cell–Surface Interactions, ACS Appl. Mater. Interfaces. 16 (2024) 4430–4438. https://doi.org/10.1021/acsami.3c16033.

[5] A. Mazare, I. Hwang, A.B. Tesler, Surface Modification of TiO_2 Nanotubes via Pre-Loaded Hydroxyapatite Towards Enhanced Bioactivity, Mater. Today Commun. under review (2024).

New sustainable processes for recycling REEs from End-of-Life magnets

Zara Cherkezova-ZHELEVA[1], **Radu-Robert PITICESCU[2*]**, Marian BURADA[2], Sabina Andreea FIRONDA[2], Daniela PANEVA[1], Anca Elena SOBETKII[2], Olivier JAY[3]

[1]Institute for Catalysis of the Bulgarian Academy of Science, Acad. G. Bonchev St., Bldg.11, Sofia, Bulgary
[2]National Research and Development Institute for Non-ferrous and Rare Metals,102 Biruintei Blvd, 077145 Pantelimon, Ilfov, Romania, *Correspondence: rpiticescu@imnr.ro
FADDTORY srl, rue Albert 1er, nr.42, 5380 FERNELMONT, Belgium/Wallonia

ABSTRACT

Rare earth elements (REEs) are vital materials for Europe's economy with a growing application in traditional and emerging sectors such as green transition, aerospace and defense, as well as large variety of equipment and hi-technology devices used in our everyday life. The current very high supply risk for REEs combines with the growing demand of REEs, driven by the Green Deal strategy for 2030.

The biggest market share is related to high-tech applications of REEs for production of magnets for electronics and communications equipment, leading to enhance the implementation of the principes of circular economy [1]. New methods were also proposed for recovery of REEs from waste electric and electronic equipment (WEEE) and other types of metallic wastes for renewable energy, robotics, electric vehicles (EVs), aerospace and defense applications.

Processing of the waste steams also prevents the deposition of the significant and increasing quantities of Nd-Fe-B magnet waste generated both as a result of production and disposal of permanent magnets at the end of their service. Annually, almost 22% (> 26,000 tons) of all REEs produced worldwide are utilized in the production of Nd-Fe-B magnets. However, only around 1% of the REE are recycled from EoL products, the rest being deposited as waste and being removed from the materials cycle [2].

The recycling routes of permanent magnets based on Nd–Fe–B may be classified in direct reuse/recycling, and indirect (or extended) recycling. Direct recycling refers to a minimal damage to the original shape of the magnet, while indirect recycling refers to several processes such as crushing, grinding, dissolution (hydrometallurgical), melting (pyrometallurgical), etc., which prolong the reinsertion of the magnet or the values recovered from them in an application.

Several direct reuse methods of Nd–Fe–B permanent magnets are currently encountered: powder re-sintering, melt spinning (MS), hydrogen decrepitation (HD) and hydrogenation-disproportionation-desorption-recombination (HDDR). Melt spinning is applied to produce textured polycrystalline powders to obtain magnets with isotropic bonds. Microwave processing and mechanochemistry emreged as new directions for recyling EoL oxidized NdFeB magnets providing powders with chemical, structural and size distribution that can be used to re-design of new magnets by additive manufacturing processes [3].

References

1. Chen, T.L.; Kim, H.; Pan, S.Y.; Tseng, P.C.; Lin, Y.P.; Chiang, P.C. Implementation of Green Chemistry Principles in Circular Economy System towards Sustainable Development Goals: Challenges and Perspectives. *Sci. Total Environ.***2020**, *716*
4. Jowitt, S.M.; Werner, T.T.; Weng, Z.; Mudd, G.M. Recycling of the Rare Earth Elements. *Curr. Opin. Green Sustain. Chem.***2018**, *13*, 1–7
5. Guo, X.; Xiang, D.; Duan, G.; Mou, P. A Review of Mechanochemistry Applications in Waste Management. *Waste Manag.***2010**, *30*, 4–10

Ultra-Slippery Wetting-Repellent Aerophilic Surfaces

Alexander B. TESLER,[1,*] Stefan KOLLE,[2,3] Lucia H. PRADO,[1] Ingo THIEVESSEN,[4] David BÖHRINGER,[4] Matilda BACKHOLM,[5] Bhuvaneshwari KARUNAKARAN,[5] Heikki A. NURMI,[5] Mika LATIKKA,[5] Lena FISCHER,[4] Shane STAFSLIEN,[6] Zoran M. CENEV,[5] Jaakko V.I. TIMONEN,[5] Mark BRUNS,[1] Anca MAZARE,[1,7] Ulrich LOHBAUER,[8] Sannakaisa VIRTANEN,[1] Ben FABRY,[4] Patrik SCHMUKI,[1,9] Robin H.A. RAS,[5,10] Joanna AIZENBERG,[2,3] Wolfgang H. GOLDMANN[4]

[1] Department of Materials Science and Engineering, Institute for Surface Science and Corrosion WW4-LKO, Friedrich-Alexander-Universität Erlangen-Nürnberg, 91058 Erlangen, Germany.

[2] Wyss Institute for Biologically Inspired Engineering, Harvard University, Cambridge, MA 02138, USA.

[3] John A. Paulson School of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138, USA.

[4] Department of Physics, Biophysics Institute, Friedrich-Alexander-Universität Erlangen-Nürnberg, 91052 Erlangen, Germany.

[5] Department of Applied Physics, School of Science, Aalto University, P.O. Box 15100, Espoo FI-02150, Finland.

[6] Department of Coatings and Polymeric Materials, North Dakota State University, Fargo, ND 58102, USA.

[7] Advanced Institute for Materials Research (AIMR), National University Corporation Tohoku University (TU), Sendai 980-8577, Japan.

[8] Department of Operative Dentistry and Periodontology, Friedrich-Alexander-Universität Erlangen-Nürnberg, 91054 Erlangen, Germany.

[9] Regional Centre of Advanced Technologies and Materials, Palacky University, Listopadu 50A, 772 07 Olomouc, Czech Republic.

[10] Department of Bioproducts and Biosystems, School of Chemical Engineering, Aalto University, Espoo FI-02150, Finland.

*Correspondence: ab.tesler@gmail.com

ABSTRACT

Wetting describes the ability of liquids to maintain contact with a solid surface, a phenomenon that is ubiquitous in nature.1 However, in engineering and medical applications, contact of solid surfaces with aqueous media leads to undesirable phenomena such as corrosion, chemo- and biofouling, which have

extremely negative economic, health, and environmental impacts. Therefore, control of wetting on solid surfaces is key to mitigating its detrimental effects. The latter can be achieved by minimizing the contact of the solid substrate with aqueous media, so-called superhydrophobic surfaces (SHS). Although SHS have been studied for decades to overcome wetting challenges,2 they are still rarely used in engineering applications.

When immersed underwater, a special type of SHS can trap air on its surface, a so-called plastron, also known as an aerophilic surface. To date, plastrons have been reported to be impractical for underwater engineering applications due to their short lifetime. Here, I will describe aerophilic surfaces made of titanium alloy (Ti) with an extended lifetime of plastron conserved for months underwater.3 The extended methodology was developed to unambiguously describe the wetting regime on such aerophilic surfaces since conventional goniometric measurements are simply impractical. My aerophilic surfaces drastically reduce the adhesion of blood, and when immersed in aqueous media, prevent the adhesion of bacteria, and marine organisms such as barnacles, and mussels. Applying thermodynamic stability theories, we describe a generic strategy to achieve long-term stability of plastron on aerophilic surfaces for demanding and hitherto unattainable applications.

References

1. Quéré, D. Wetting and Roughness. *Annual Review of Materials Research* **2008**, *38* (1), 71-99.
2. Cassie, A. B. D.; Baxter, S. Wettability of porous surfaces. *Transactions of the Faraday Society* **1944**, *40*, 546-551.
3. Tesler, A.B.; Kolle, S.; Prado, L.H.; Thievessen, I.; Böhringer, D.; Backholm, M.; Karunakaran, B.; Nurmi, H.A.; Latikka, M.; Fischer, L.; Stafslien, S.; Cenev, Z.M.; Timonen, J.V.I.; Bruns, M.; Mazare, A.; Lohbauer, U.; Virtanen, S.; Fabry, B.; Schmuki, P.; Ras, R.H.A.; Aizenberg, J.; Goldmann, W.H. Long-Lasting Aerophilic Metallic Surfaces Underwater. *Nature Materials* **2023,** 22, 1548–1555.

ORAL PRESENTATIONS

Antimicrobial and biodegradable electrospun nanofiber composite for wound dressing

Abdul Bari Yaqub[1,2], Musa Ayran[1,2,], Elif Kaya[1,2], Aysegul Tiryaki[1,2], Songul Ulag[1,3], Gülgün Bosgelmez Tinaz[4],Oguzhan Gunduz[1,3]*

[1] Marmara University, 34000 Istanbul, Turkiye

[2] Center For Nanaotechnology & Biomaterials Applications and Reserch, Marmara University 34000 Istanbul, Turkiye

*Correspondence: abdulbari438@yahoo.com

ABSTRACT

Throughout history, wound dressings have undergone numerous significant enhancements. Evolution started with the utilization of natural materials for basic wound heeling and progressed to employing innovative techniques that can be tailored to execute various remarkable functions. Conventional wound dressings necessitate frequent replacement, are susceptible to bacterial proliferation, and contribute significantly to environmental pollution. Hence, there's a growing demand for biodegradable and antibacterial dressings. Modern wound dressings, crafted from electrospun polymers, incorporate diverse active compounds, like antimicrobial agents, to facilitate wound healing while safeguarding against dehydration and infection.

In this study, Peo/SA fibers were initially prepared via electrospinning, suggesting their potential as materials for wound dressings. Morphology, composition, cytotoxicity, and antibacterial activity of nano fibers were characterized by using Fourier transform infrared spectroscopy, differential scanning calorimetry , Scanning electron microscopy , Rheological testing, Swelling Degradation, Tensile testing, Antimicrobial and Biocompatibility test. The results indicate uniform dispersion of SA particles across Peo fibers' surface, with no observed cytotoxic effects. Moreover, the Peo/SA fibers demonstrate remarkable antibacterial efficacy against both Staphylococcus aureus (S. aureus) and Escherichia coli (E. coli), leading to a substantial decrease in bacterial count. Hence, this biodegradable, non-toxic, and antibacterial fiber holds great promise for applications in wound dressing.

References

1. Chen Y, Lu W, Guo Y, Zhu Y, Song Y. Electrospun Gelatin Fibers Surface Loaded ZnO Particles as a Potential Biodegradable Antibacterial Wound Dressing. *Nanomaterials*. 2019; *9*(4): 525. https://doi.org/10.3390/nano9040525
2. Parham S, Kharazi AZ, Bakhsheshi-Rad, Kharaziha M, Ismai AF, Sharif S, Razzaghi M, RamaKrishna S, Berto F. Antimicrobial Synthetic and Natural Polymeric Nanofibers as Wound Dressing: A Review. Advanced Engineering Materials. 2022; https://doi.org/10.1002/adem.202101460

Utilizing Cassia Occidentalis as a Natural Reducing and Stabilizing Agent for Titanium Oxide Nanoparticles in Photocatalytic Applications

Abubakar Dantani Meli[1], Mohamed Abdelmonem[1], Che Azurahanim Che Abdullah[*,1,2]

[1]Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400, UPM Serdang, Selangor, Malaysia

[2]Department of Mathematics and Sciences, Ajman University, Ajman P.O. Box 346, United Arab Emirates

*Correspondence: abubakarmeli4@gmail.com

ABSTRACT

"Green nanotechnology" is a rapidly expanding discipline that integrates principles of green chemistry with the objectives of sustainability, safety, and overall human well-being. Green chemistry aims to minimize environmental and human health risks by designing, manufacturing, and utilizing less hazardous chemicals. Implementing this approach requires a thorough understanding of raw materials, especially in their transformation into nanomaterials with minimal adverse effects on the environment and human health. In the 21st century, nanotechnology has become a pivotal scientific breakthrough. Extensive research has been conducted on the physiological, technical, and chemical properties of metallic nanoparticles, encompassing both metal and metal oxide nanoparticles. Biological synthesis methods are increasingly favored due to their simplicity, cost-effectiveness, and production of environmentally benign nanoparticles. Key reducing and oxidizing agents in these processes include proteins, phenolics, flavonoids, terpenoids, and amino acids. Additionally, there is ongoing debate regarding the use of plants in nanoparticle synthesis. This study explores the foundational concepts of green synthesis techniques, particularly emphasizing metals, and metal oxides like TiO2, and investigates the roles of terpenoids and proteins as oxidizing agents and chemical stabilizers. The application of plants in green synthesis remains a contentious issue.

References

1. Abazović, N. D., Čomor, M. I., Dramićanin, M. D., Jovanović, D. J., Ahrenkiel, S. P., & Nedeljković, J. M. (2006). Photoluminescence of Anatase and Rutile TiO $_2$ Particles. *The Journal of Physical Chemistry B*, *110*(50), 25366–25370. https://doi.org/10.1021/jp064454f
2. Abdalla, H., Adarosy, M. H., Hegazy, H. S., & Abdelhameed, R. E. (2022). Potential of green synthesized titanium dioxide nanoparticles for enhancing seedling emergence, vigor and tolerance indices and DPPH free radical scavenging in two varieties of soybean under salinity stress. *BMC Plant Biology*, *22*(1), 560. https://doi.org/10.1186/s12870-022-03945-7

Catechols: A Never-Ending Story of Building Innovative Polymeric Materials

Alin-Ionuț Alecu[1*], Ana-Maria Albu[1*], Celina Maria Damian[1b], Andra Mihaela Onaș[1b], Cristina Stavarache[1b,c], Roxana Trușcă[2]

[1]Faculty of Chemical Engineering and Biotechnologies, Department of Bioresources and Polymer Science; National University of Science and Technology Politehnica Bucharest, 1–7 Gh. Polizu Street, Bucharest 011061, Romania, alin_ionut.alecu@stud.chimie.upb.ro; anamaria.albu@upb.ro,

[1b]Advanced Polymer Materials Group, National University of Science and Technology Politehnica Bucharest, 1–7 Gh. Polizu Street, Bucharest 011061, Romania, celina.damian@upb.ro; andra_mihaela.onas@upb.ro; cristina.stavarache@upb.ro

[2]Faculty of Chemical Engineering and Biotechnologies, Department of Science and Engineering of Oxide Materials and Nanomaterials, National University of Science and Technology POLITEHNICA Bucharest, 011061 Bucharest, truscaroxana@yahoo.com; troxana_doina.trusca@upb.ro

[3]"COSTIN D. NENITZESCU"-Institute of Organic and Supramolecular Chemistry, 202B Splaiul Independentei Street, Bucharest

[*]Correspondence: alin_ionut.alecu@stud.chimie.upb.ro; anamaria.albu@upb.ro

ABSTRACT

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

Polyaniline-Based Room Temperature Methane Gas Sensor

Ana-Maria Popa[1,2], Andrei Stochioiu[1,2], Luiza-Izabela Toderașcu[1], Vlad-Andrei Antohe[2], Gabriel Socol[1] and Iulia Antohe[1,3,*]

[1]National Institute for Laser, Plasma and Radiation Physics (INFLPR), Atomiștilor Street 409, 077125 Măgurele, Ilfov, Romania

[2]Faculty of Physics, Research and Development Center for Materials and Electronic & Optoelectronic Devices (MDEO), University of Bucharest, Atomiștilor Street 405, 077125 Măgurele, Ilfov, Romania

[3]Academy of Romanian Scientists (AOSR), Ilfov 3, 050044 Bucharest, Romania

*Correspondence: iulia.antohe@inflpr.ro; gabriel.socol@inflpr.ro

ABSTRACT

Many industries such as the healthcare industry, industrial safety and environmental monitoring require gas detection equipment. The precise and quick detection of various gases, including methane (CH4) is a very important factor in recognizing possible hazards, ensuring workplace safety and managing emissions. [1] Chemiresistive sensors based on conductive polymers such as polyaniline have shown great sensitivity, quick reaction time and adaptability, making them promising tools for gas detection at room temperature [2,3].

In this study, polyaniline (PANi) conductive polymer was selected due to its well-known adaptability to a variety of gases, including ammonia, hydrogen, and methane. [4] This polymer was synthesized via chemical polymerization of its monomer directly on the interdigitated gold electrodes and its properties have been further investigated using scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) to provide morphological and chemical information. Additionally, an in-house gas testing equipment was used to electrically characterize the developed sensor. Using a source-meter, the electrical characteristics of the sensor inside the gas chamber were examined while it was subjected to different CH4 concentrations ranging from 1 to 20 ppm.

In conclusion, the data acquired showed that the suggested sensor demonstrates a noticeable decrease in electrical resistance upon exposure to the analyte, indicating its high sensitivity to detect small concentrations of the analyte. The sensitivity and limit of detection (LOD) for this sensor were evaluated and found to have good values according to the literature. The LOD was determined to be below 1 ppm, specifically 0.75 ppm.

Keywords: polyaniline, conductive polymers, chemiresistive gas sensors, methane sensingâ

Acknowledgments: This research was supported by the National Authority for Research and Innovation in the framework of the Nucleus Programme—LAPLAS VII (grant 30N/2023) and by the "Academy of Romanian Scientists" (AOSR), Ilfov 3, 050044 Bucharest, Romania.

References

2. Leve, Z.D. et al.; The Synergistic Properties and Gas Sensing Performance of Functionalized Graphene-Based Sensors, Materials 15, 2022.
3. Luo, S.X.L. and Swager, T.M.; Chemiresistive Sensing with Functionalized Carbon Nanotubes, Nature Reviews Methods Primers 3, 73, 2023.
4. Liu, X. et al.; Conducting Polymer-Based Nanostructures for Gas Sensors, Coordination Chemistry Reviews 462, 214517, 2022.
5. Fratoddi, I. et al.; Chemiresistive Polyaniline-Based Gas Sensors: A Mini Review, Sensors and Actuators B-chemical 220, 534–548, 2015.

Potential applications of cellulose-acetate based polymeric membranes

Ananda Barman, Polash Dutta, Karanjit Kapila

Tezpur university, Mechanical Engineering Department, Assam-784028, India

ABSTRACT

Cellulose acetate-based polymeric membranes have garnered significant attention due to their versatile applications in various fields. These membranes, derived from cellulose, offer unique properties such as biocompatibility, biodegradability, and excellent mechanical strength, making them suitable for a wide range of uses. In environmental applications, cellulose acetate membranes are employed in water purification processes, including microfiltration, ultrafiltration, and reverse osmosis, to remove contaminants and provide safe drinking water. In the medical sector, they are utilized in hemodialysis and drug delivery systems due to their selective permeability and low toxicity. Furthermore, these membranes find applications in the food industry for processes like dairy filtration and clarification of beverages. Recent advancements have also explored their potential in gas separation and as a support for enzyme immobilization in biochemical processes. The increasing need for efficient and sustainable gas separation technologies has driven significant research into advanced materials for selective gas separation processes. This study focuses on the development and characterization of cellulose acetate (CA) polymeric membranes, examining a range of concentrations (2-15 wt.%) to determine optimal film properties. The membranes were fabricated using solution casting and phase inversion techniques, with specific attention to polymer concentration for optimizing the base film. Comprehensive physical, mechanical, morphological, and biodegradability analyses were conducted. The results indicated that a 10 wt.% CA concentration produced films with the highest tensile strength and elongation at break, as well as minimal surface defects, as observed through SEM analysis. Additionally, barrier and biodegradability assessments demonstrated that the 10 wt.% CA film exhibited low water vapor permeability (5.580×10^{-5} g/m.h.Pa) and significant biodegradation (31.65% over 30 days). These findings suggest that CA membranes at 10 wt.% concentration possess superior film-forming properties and hold promise for further development into polymer nanocomposite membranes with the incorporation of various nanofillers. This work underscores the potential applications of CA-based membranes in enhancing gas separation processes, contributing to the advancement of sustainable material technologies.

References

[1] Arthanareeswaran, G.; Thanikaivelan, P.; Srinivasn, K.; Mohan, D.; Rajendran, M. Synthesis, characterization and thermal studies on cellulose acetate membranes with additive. *European Polymer Journal* **2004**, *40* (9), 2153-2159.

[2] Devi, L.M.; Lalnunthari, C.; Badwaik, L.S. Direct transformation of muskmelon seeds meal into biodegradable films and their characterization. *Journal of Polymers and the Environment* **2019**, *27*, 456-463.

[3] Lee, H.J., Jung, B., Kang, Y.S., and Lee, H. Phase separation of polymer casting solution by nonsolvent vapor. *Journal of Membrane Science*, 245(1-2):103-112, 2004.

[4] Zarei, A. and Ghaffarian, V. Preparation and characterization of biodegradable cellulose acetate-starch membrane. *Polymer-Plastics Technology and Engineering*, *52*(4):387-392, 2013.

Decellularized algae as complex structures for skin tissue engineering

Andreea Luca[1], Maria Stella Pascal[1], Teodora Vlad[1], Florina Daniela Cojocaru[1], Maria Butnaru[1], Liliana Vereștiuc[1]

[1] Grigore T. Popa University of Medicine and Pharmacy of Iași, Faculty of Medical Bioengineering, 9-13 Mihail Kogalniceanu Street, 700454, Iasi, Romania, *andreea.luca@umfiasi.ro

ABSTRACT

The extracellular matrix replacing is a challenging task for a biomaterial, due to the complex functions, such as mechanical support, biological cues for cell attachment, nutrient exchange. Plants offer structural diversity through numerous geometries and surfaces, and plant derived scaffolds have gained a great interest in tissue engineering applications, based on their cytocompatibility and accessibility [1, 2]. Such resource is represented by macroalgae, especially modified by decellularization, resulting cellulose-based scaffolds that can be used, alone or in combinations, as biomimetic structures. Through biofunctionalization, the decellularized matrix becomes an optimal medium for cell adherence and proliferation facilitating the formation of functional tissues [3].

Macroalgae present the advantage of an accessible resource, easy to manipulate due to its cellulose-derived resistance. This study reports the obtaining and characterization of scaffolds resulted by red and green sea algae decellularization, and to test their potential applications for skin tissue engineering. The decellularization process was performed using two different surfactants, SDS and Triton X-100, and for scaffold stabilization was oven drying or lyophilization was used. The process was observed macroscopically and also through stereomicroscopy and inversed microscopy. The hydration degree was tested for the oven dried and lyophilized decellularized algae, comparing the red and green algae. An important aspect that was also tested was the bioadhesive properties, key characteristics for scaffolds intended for skin tissue engineering. After decellularization the cytocompatibility of the structures was tested by MTT method and also it was observed the morphology of HaCaT cell line when kept for 72 hours in the presence of the scaffolds, compared to control cells. The decellularized algae were repopulated with keratinocytes and it was observed that the green algae permitted a better cell adhesion and proliferation on their surface compared to the red algae. All the decellularized algae presented cytocompatibility when tested in the presence of keratinocytes and good bioadhesive properties making them an attractive alternative to laboratory synthetized matrices for applications that involve the mimiking structures of the native tissues.

References

1. Bar-Shai, N., Sharabani-Yosef, O., Zollmann, M., Lesman, A., & Golberg, A. (2021). Seaweed cellulose scaffolds derived from green macroalgae for tissue engineering. Scientific reports, 11(1), 11843
2. Yagmur Arslan, Alessia Paradiso, Naz Celiktas, Tolga Erdogan, Ozlem Yesil-Celiktas, Wojciech Swieszkowski (2023). Bioinspired microstructures through decellularization of plants for tissue engineering applications, European Polymer Journal, 198, 112415
3. McInnes, Adam D., Michael A. J. Moser, Xiongbiao Chen (2022). Preparation and Use of Decellularized Extracellular Matrix for Tissue Engineering. *Journal of Functional Biomaterials*, 13 (4), 240

Biological Applications of Bis-Thiosemicarbazones with a Cyclohexyl Ring

Andrei Ciursin, Ion Bulimestru, Roman Rusnac

Moldova State University, Chisinau, Republic of Moldova

*Correspondence: ciursin.andrei@usm.md

ABSTRACT

Thiosemicarbazones are organic substances, derivatives of Schiff bases. They are of great interest because of their remarkable biological properties, including antibiotic, antitumour, antioxidant, antifungal and anticancer activities. In addition to this they are also interesting from the point of view of ligands in coordination chemistry. There are many studies in the field of thiosemicarbazones, but despite of that not many research articles describe bis-thiosemicarbazones, although they are also of significant interest. In this work, the synthesis of some bis-thiosemicarbazones will be described, as well as some possible biological applications will be evaluated.

Aldehyde 1 was synthesized using the procedure described in source [1]. For the synthesis of thiosemicarbazone one equivalent of aldehyde (1) was mixed with two equivalents of the respective thiosemicarbazide. The mixture was refluxed for 8 hours. The obtained solid was filtered and washed with ethanol. The structure of the synthesized substances was confirmed by ^{1}H and ^{13}C NMR spectroscopy.

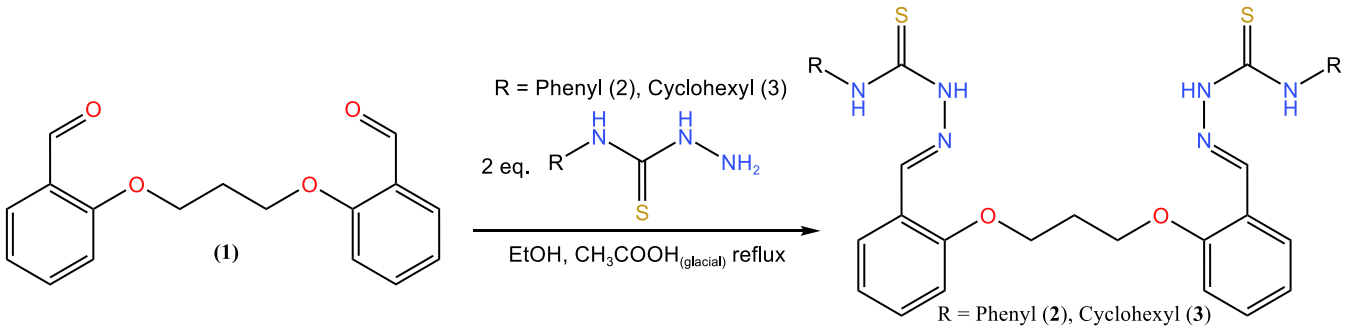


Figure 1. Scheme of *bis*-tiosemicarbazones synthesis

For the initial assessment of biological potential, antioxidant analysis was performed with the ABTS cation-radical inhibition method. The IC_{50} for substance 2 was determined to be – 46,13 µM and for substance 3, it exceeded the value of 100 µM, which indicated, that there is no significant antioxidant activity in this case.

The molecular docking method was also applied to evaluate the potential of the synthesized substances to have antibiotic activity. The target of inhibition was DNA Gyrase (PDB: 1aj6). It was found that binding affinity to DNA Gyrase of compound 2 is -7.9 kcal/mol and for compound 3 is -7.6 kcal/mol. In comparison,

the binding affinity of known inhibitor Novobiocin is -6.30 kcal/mol, which indicates the potential for good antibacterial activity of the synthesized compounds.

References

1 .Darabi, H.R., Rastgar, S., Aghapoor, K. et al. Pinacolophanes as versatile precursor for the practical synthesis of tolanophanes. Monatsh Chem 149, 1121–1124 (2018). https://doi.org/10.1007/s00706-017-2125-3

NiCrAlY Layers Performance Assessment Developed onto 310H Alloy by EB-PVD Method After Oxidation in Aggressive Conditions

Aurelia Elena Tudose[1,2,*], Ioana Demetrescu[2,3], Florentina Golgovici[2], Manuela Fulger[1], Diana Diniași[1], Radu-Robert Piticescu[4]

[1]Institute for Nuclear Research Pitesti, POB 78, 1 Campului Street, 115400 Mioveni, Romania

[2]Department of General Chemistry, National University of Science and Technology Politechnica Bucharest, 313 Splaiul Independentei, 060042 Bucharest, Romania

[3]Academy of Romanian Scientists, 3 Ilfov, 050094 Bucharest, Romania

[4]National Research & Development Institute for Non-ferrous and Rare Metals, Bucharest, Romania

*Correspondence: aurelia.tudose@nuclear.ro

ABSTRACT

The paper aims is the assessment of corrosion behaviour of a NiCrAlY-coated 310 H stainless steel under simulated supercritical water conditions (550°C and 25 MPa) for up to 2160 h. The NiCrAlY coating with a thickness of 1,5 µm was obtained by Electron Beam Physical Vapor Deposition. The oxides grown on this coating were characterized using scanning electron microscopy (SEM) and grazing incidence X-ray diffraction (GIXRD). By SEM investigations it was observed that the deposited layer is granular, no visible defects (pores, cracks). After oxidation a thin, compact and fairly uniform oxide layer has been deposited on the surface of these samples. By GIXRD analysis, the presence of Cr2O3 on the surface of the autoclaved NiCrAlY-coated 310 H samples were highlighted. Corrosion susceptibility assessment was performed using two electrochemical method: impedance spectroscopy (EIS) and linear potentiodynamic polarization. EIS impedance spectra show the presence of two capacitive semicircles in the Nyquist diagram, highlighting both the presence of the NiCrAlY coating and the oxide film formed during oxidation on the 310 H stainless steel. Very low corrosion rates, with values up to 12,6 nm×year^{-1}, obtained in the case of NiCrAlY-coated samples after 2160 h of oxidation indicated that the oxides formed on these samples are protective and provide better corrosion resistance.

References

1. M. Urbina, A. Rinaldi, S. Cuesta-Lopez and e. al., "The methodologies and strategies for the development of novel material systems and coatings for applications in extreme environments-a critical review," *Manufacturing Review*, vol. 5, p. 9, 2018.
2. X. Huang, Q. Yang and D. Guzonas, "Performance of Chemical Vapor Deposition and Plasma Spray - Coated Stainless Steel 310 in Supercritical Water," *Journal of Nuclear Engineering and Radiation*, vol. 2, no. 2, pp. 1011-1 - 1011-8, April 2016, doi:10.1115/1.4031198
3. X. Huang and D. Guzonas, "Characterization of Ni - 20Cr - 5Al model alloy in Supercritical Water," *Journal of Nuclear Materials*, no. 445, pp. 298-307, 2014, http://dx.doi.org/10.1016/j.nucmat.2013.11.011.

Production of Nanofibers by Coaxial Electrospinnig Method Using Bacterial Cellulose Synthesized Using Orange Peel Extract and PCL/PLA Composite

Aysenur Avcı[1], Melike Naz Sayan[1], Rabia Betul Sulutas[2,3] , Aslıhan Calhan[1,2] Sumeyye Cesur[2], Oguzhan Gunduz[2,3], Cem Bülent Üstündağ[1]

[*1]Yildiz Technical University, Faculty of Chemical and Metallurgical Engineering, Department of Bioengineering, Istanbul, Turkey

[2]Center for Nanotechnology & Biomaterials Application and Research (NBUAM), Marmara University, Turkey, ucemogu@ucl.ac.uk

[3]Department of Metallurgical and Materials Engineering, Faculty of Technology, Marmara University, Turkey

ABSTRACT

Polycaprolactone (PCL) and polylacticacid (PLA) are nanofiber materials that are frequently used in various industrial and medical applications. PCL has advantages such as high flexibility and biodegradability, but it is also limited by low mechanical qualities and gas barrier capabilities. PLA, on the other hand, has a glassy structure that makes it rigid and has a high tensile strength, but it also has brittleness and low elasticity. However, combining PCL and PLA preserves the benefits of each polymers while reducing their limitations [1].

Bacterial cellulose (BC) is a naturally occurring polymer produced by certain bacteria, particularly Gluconacetobacter genus, and holds unique properties such as high crystallization, elasticity, and water retention capacity [2].The use of bacterial cellulose in the production of nanofibers is employed in the medical field as a temporary skin dressing for wounds due to its high water retention capacity.

Electrospinning is a simple, ergonomic, and cost-effective method for producing nanofibers by spraying a polymer solution under a high electric field [3]. Coaxial electrospinning, on the other hand, allows for loading bioactive compounds into core and shell layers, achieved by controlling spinning solutions separately using two distinct drive systems [4].

In this study, core-shell nanofibers were produced using the coaxial electrospinning method. The core solutions were poly(L-lactic acid) (PLA) and polycaprolactone (PCL), while the core solution was bacterial cellulose (BC) obtained from orange peel waste. The purpose of obtaining bacterial cellulose (BC) from orange peel waste is both to enable the production of high-value products and to reduce the cost of BC production. Electrospinning solutions were prepared by dissolving BC and adding Tween 80, and then mixing PCL and PLA in chloroform and dimethylformamide (DMF). The fibers were produced under optimized conditions in which PCL/PLA was used as the core and ascorbic acid (AA-BC) BC as the shell. The nanofibers were characterized using SEM, FT-IR, DSC, tensile test. The results of this study are thought

to potentially guide future research on the use of bacterial cellulose nanofibers produced from agricultural waste in biomedical applications.

References

[1] Kakroodi, A. R., Kazemi, Y., Rodrigue, D., & Park, C. B. (2018). Facile production of biodegradable PCL/PLA in situ nanofibrillar composites with unprecedented compatibility between the blend components. Chemical Engineering Journal, 351, 976-984.

[2] Hussain, Z., Sajjad, W., Khan, T., & Wahid, F. (2019). Production of bacterial cellulose from industrial wastes: a review. Cellulose, 26(5), 2895-2911.

[3] Chou, S. F., Carson, D., & Woodrow, K. A. (2015). Current strategies for sustaining drug release from electrospun nanofibers. Journal of Controlled Release, 220, 584-591.

[4] Chen, J., Zhang, G., Zhao, Y., Zhou, M., Zhong, A., & Sun, J. (2022). Promotion of skin regeneration through co-axial electrospun fibers loaded with basic fibroblast growth factor. Advanced composites and hybrid materials, 5(2), 1111-1125.

Fabrication of ethosuximide loaded polycaprolactone/bismuth ferrite-based 3D-printed scaffolds and controlled drug release in electric field for the treatment of epilepsy

Aysim Cisen Akyol[1,2], Esra Ozdemir[1,2], Hatice Karabulut[1], Songul Ulag[1,3*], Zehra Kanli[4], Banu Aydin Omay[4], Oguzhan Gunduz[1,3]

[1]Center for Nanotechnology & Biomaterials Application and Research (NBUAM), Marmara University, Istanbul, Turkey

[2]Department of Bioengineering, Faculty of Chemical and Metallurgical Engineering, Yıldız Technical University, Istanbul, Turkey

[3]Department of Metallurgical and Materials Engineering, Faculty of Technology, Marmara University, Istanbul, Turkey

[4]Department of Biophysics, School of Medicine, Marmara University, Istanbul, Turkey

***Correspondence:** songul.ulag@marmara.edu.tr

ABSTRACT

Over 50 million people worldwide suffer from epilepsy, a persistent neurological disorder. This disorder arises from abnormal electrical activity that can target a specific region or the entire brain. Reducing seizure frequency and intensity while lowering medication-induced brain and other tissue damage is the main objective of epilepsy treatment. Antiepileptic drugs (AEDs) are commonly administered orally or intravenously, yet these treatments may not always yield desired results. The blood-brain barrier, which prevents AEDs from entering and staying in the brain, is one of the biological processes that severely limits drug access to the brain.(1) Patients who do not respond to AEDs are classified as having drug-resistant epilepsy, contributing substantially to the global epilepsy burden, with approximately 25% of epilepsy cases being drug-resistant.

This strategy has gained popularity as a viable option in recent years because to the increased interest in administering medications directly to the specific area of the brain where seizures take place. One method involves creating polymeric implants loaded with drug, which can be precisely administered to the seizure site for controlled and targeted delivery. By utilizing this localized drug delivery system, AEDs can be effectively directed to the brain parenchyma, bypassing the blood-brain barrier (BBB) to achieve higher drug concentrations at the seizure focus while minimizing systemic side effects. In this paper ethosuximide (ETHX), a commonly used AED, is selected as active ingredient of implantable drug delivery system at different amounts (10, 12.5, 15 mg)(2). In order to improve the releasing mechanism for an intracranial administration, the poly(ε)caprolactone (PCL) scaffolds (25% w/v) with different pore sizes were produced by 3D printing. Additionally, bismuth ferrite (BFO), synthesized via co-precipitation method, is added to PCL scaffolds at amount of 3.75 mg to facilitate controlled drug release under electrical stimulation.

Tensile testing, differential scanning calorimetry (DSC), scanning electron microscopy (SEM), and fourier transform infrared spectroscopy (FTIR) were used to assess the 3D-printed scaffolds that were

created. The human neuroblastoma cell line (SH-SY5Y) was used in MTT experiments to demonstrate the scaffolds' biocompatibility(3). Furthermore, in comparison to traditional drug-release methods, electrically conductive 3D-printed scaffolds improved the drug release capabilities by showing that ETHX may be released much faster by applying the electric field.

References

1. Bhadran *et al.*, 'Recent Advances in Polycaprolactones for Anticancer Drug Delivery', *Pharmaceutics*, vol. 15, no. 7, p. 1977, Jul. 2023
2. van Tienderen, G. S., Berthel, M., Yue, Z., Cook, M., Liu, X., Beirne, S., & Wallace, G. G. (2018). Advanced fabrication approaches to controlled delivery systems for epilepsy treatment. *Expert Opinion on Drug Delivery*, *15*(9), 915–925. https://doi.org/10.1080/17425247.2018.1517745
3. S. Ilgar, S. Ulag, A. Sahin, O. Gunduz, and C. B. Ustundag, 'Controlled Delivery of Amoxicillin and Rifampicin by Three-Dimensional Polyvinyl alcohol/Bismuth Ferrite Scaffolds', *ChemistrySelect*, vol. 8, no. 18, p. e202204798, 2023, doi: 10.1002/slct.202204798.

Application of Response Surface Methodology (RSM) for Optimization of Synthesis Parameters of rGO@MnO_2 Nanocomposites as Electrode Materials for Asymmetric Supercapacitor Device

Balarabe **El-yaqub**[1,2], Mohd Haniff **Wahid**[1*], Abdul Halim **Abdullah**[1], Wan Azlina Wan **Ab Karim Ghani**[3]

[1]Department of Chemistry, Faculty of Science, Universiti Putra Malaysia
[2] Department of Chemistry, Faculty of Science, Nigerian Defence Academy, Kaduna State, Nigeria
[3] Department of Chemical and Environmental Engineering, Faculty of Engineering, Universiti Putra Malaysia
*Corresponding author's phone: +603-9769 6784, E-mail: mw_haniff@upm.edu.my

ABSTRACT

The response surface methodology (RSM) was utilized to enhance the performance of MnO_2-doped rGO nanocomposite synthesized via hydrothermal process for supercapacitor applications. The RSM statistically determined the optimum parameters for the synthesis of MnO_2-rGO nanocomposites. Polypyrrole (PPy) was used to enhance the electrochemical performance of the nanocomposites. The nanocomposites were characterized using the following techniques: transmission electron microscopy (TEM), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Brunauer-Emmett-Teller (BET) and Barret- Joyner-Halenda (BJH) methods and energy dispersive X-ray analysis (EDX). From RSM modelling, a second order polynomial equation was generated to show the relationship between the variables. Analysis of fit (ANOVA) was also used to determine the significance of the fitted equation and the F test resulted in an F value of 144.68 which suggested that the model had adequate significance ($P<0.0001$). An R^2 value of 0.9924 indicated how effectively the model can predict experimental data sets. From the RSM model, the optimized condition was found to be at a ratio of rGO(mg): MnO_2(mg): hydrothermal temperature(^oC) (1:1:24) (Agudosi et al., 2021; Razmi et al., 2021).

Complex Polymeric Matrices with Antibacterial and Antioxidant Inclusions

Bianca-Elena-Beatrice Cretu[1,*], Gianina Dodi[2], Ioannis Gardikiotis[3], Vera Balan[2], Alina Gabriela Rusu[1], Alina Ghilan[1], Loredana Elena Nita[1], Aurica P. Chiriac[1]

[1]Petru Poni Institute of Macromolecular Chemistry, 41 A Grigore Ghica Voda Alley, 700487 Iasi, Romania
[2]Faculty of Medical Bioengineering, Grigore T. Popa University of Medicine and Pharmacy of Iasi, 9-13 Kogalniceanu Street, 700454 Iasi, Romania
[3]Advanced Research and Development Center for Experimental Medicine, Grigore T. Popa University of Medicine and Pharmacy of Iasi, 9-13 Kogalniceanu Street, 700454 Iasi, Romania
*Correspondence: cretu.bianca@icmpp.ro

ABSTRACT

Given the increasing resistance of pathogenic microorganisms to the action of antibiotics, essential oils extracted from plants with therapeutic activity provide a significant alternative in obtaining dressings for the treatment of skin wounds. The encapsulation of essential oils in an amphiphilic gel network allows better dispersion and preservation of hydrophobic bioactive substances while promoting their prolonged release.

In this study, we introduce a new cryogel system based on poly(vinyl alcohol) (PVA) and poly(ethylene brassylate-co-squaric acid) (PEBSA) which is used as matrix for the encapsulation of thymol (Thy) and α-tocopherol (α-Tcp) bioactive agents. The development of new complex materials with antibacterial and antioxidant activity is proposed for the treatment and healing of skin wounds. The presented investigation includes the physicochemical properties of the cryogel systems in terms of their chemical composition, network morphology, release profiles, antibacterial and antioxidant dual activity. The applicability of the complex bioactive system was investigated through cell proliferation, a biocompatibility test, and an *in vivo* wound healing assay in a full-thickness excision wound rat model.

Thy_α-Tcp release profiles from polymeric cryogels confirmed the ability of PVA_PEBSA system to encapsulate these bioactive compounds. The PVA_PEBSA_Thy_α-Tcp systems proved antibacterial activity against *Staphylococcus aureus* ATCC25923 (Gram-positive bacterial strain), *Candida albicans* ATCC10231 (fungal strain), and *Escherichia coli* ATCC25922 (Gram-negative bacterial strain). The cumulative antioxidant efficiency of Thy and α-Tcp, which in combination with the PEBSA copolymer have a synergistic effect (97.1%). BALB/3T3 fibroblast cell culture demonstrated the cryogel scaffolds' cytocompatibility. Animal testing confirmed their biocompatibility, integration with host tissue, and the absence of inflammatory processes. The bioactive compound significantly enhanced the healing process of full-thickness excision wounds in a rat model. In light of the promising outcomes, PVA_PEBSA cryogels with dual activity can be considered promising wound dressings.

Acknowledgments: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS/CCCDI–UEFISCDI, project number PN-III-P1-1.1-TE-2019-1671, within PNCDI III.

References

6. Pan, Z. et al. *APL Bioengineering* **2021**, 5, 011504, doi: 10.1063/5.0038364.
7. Crețu, B.-E.-B. et al. *Gels* **2023**, 9, 174, doi:10.3390/gels9030174.
8. Crețu, B.-E.-B. et al. *Pharmaceutics* **2023**, 15, 2730, doi:10.3390/pharmaceutics15122730.

Characterization and Antibacterial Activity of Zinc Oxide Nanoparticles Synthesized via Non-Thermal Plasma Process

Bounedjar Nourelhouda [1,2*], Ferhat Mohammed Fouad [1,3,4], Toukal Linda [5], Anton Ficai [6,7,8,9]

[1] Renewable Energy Development Unit in Arid Zones, El-Oued University, B.P. 789, 39000, Algeria.
[2] Department of Chemistry, Faculty of Exact Sciences, University of El-Oued, B.P. 789, 39000, Algeria
[3]Laboratory of Sciences and Techniques of the Environment and Valuation, Ibn Badis-Mostaganem University, Algeria.
[4] Department of Process Engineering, Faculty of Technology, University of El Oued, B.P. 789, 39000, Algeria.
[5] Laboratory of Electrochemistry and Material (LEM), Department of Process Engineering, Faculty of Technology, University of Setif 1, 19000, Algeria.
[6] Science and Engineering of Oxide Materials and Nanomaterials, Faculty of Chemical Engineering and Biotechnologies, National University of Science and Technology POLITEHNICA Bucharest, Gh. Polizu 1-7, 011061 Bucharest, Romania
[7] National Center for Scientific Research for Food Safety, National University of Science and Technology POLITEHNICA Bucharest, Splaiul Independentei 313, 060042 Bucharest, Romania
[8] National Center for Micro and Nanomaterials, National University of Science and Technology POLITEHNICA Bucharest, Splaiul Independentei 313, 060042 Bucharest, Romania
[9]Academy of Romanian Scientists, Ilfov Street 3, 050044 Bucharest, Romania

*Correspondence: nourelhouda-bounedjar@univ-eloued.dz

ABSTRACT

This study aims to investigate the synthesis, characterization, and antibacterial efficacy of zinc oxide nanoparticles synthesized through a non-thermal plasma process. The synthesis involved treating a 0.1 M solution of zinc acetate dihydrate in a GAD-air reactor under 9 kV and 16 l/min of humid air, followed by annealing at 700 °C, the resulted product was then characterized using multiple thecniques. DRX, SEM, and EDX analyses revealed a median crystallite size of 62.46 nm and predominantly rod-like structures, with a composition primarily of zinc and oxygen. The antibacterial properties of these nanoparticles were assessed against Pseudomonas aeruginosa and Klebsiella pneumoniae using the Agar well diffusion method with concentrations ranging from 10 mg/l to 40 mg/l. Results indicated a concentration-dependent antibacterial activity, with Pseudomonas showing modest inhibition zones (10 mm to 13 mm), suggesting relative resistance, while Klebsiella exhibited larger zones (14 mm to 17 mm), indicating moderate susceptibility. These findings highlight the potential of ZnO NPs synthesized via NTP for specific antibacterial applications, with efficacy varying across different bacterial strains.

References

1 Bounedjar N, Ferhat MF, Toukal L, Messai R. Non thermal plasma synthesis of ZnO nanoparticles and their corrosion inhibition activity on XC70 mild steel pipeline in 1 M HCl acidic medium. Mater Chem Phys. 2024;311:128555.

2 Ridha M, Messai F, Belmekki B, Alam MW, Al-Othoum M, Sadaf S. GAD Plasma-Assisted Synthesis of ZnO Nanoparticles and Their Photocatalytic Activity. Materials Research Express. 2024;11.Petrișor G, Motelica L, Trușcă RD, Mîrț AL, Vasilievici G, Tomescu JA, Manea C, Dumbravă AȘ, Corbu VM, Gheorghe-Barbu I, et al. The Antimicrobial Potency of Mesoporous Silica Nanoparticles Loaded with Melissa officinalis Extract. Pharmaceutics. 2024;16:525.

Synthesis and Characterization of Propolis Loaded Microspheres and Investigation of Health Effects

Busra Sinan[1,2*], Elif Ilhan [2], Oguzhan Gunduz[2,3], Adviye Gulcin Sagdıcoglu Celep[4]

[1] Department of Advanced Technologies, Gazi University, Turkey, *Correspondence: busrasinan@gmail.com

[2]Center for Nanotechnology & Biomaterials Application and Research (NBUAM), Marmara University, Turkey

[3]Department of Metallurgical and Materials Engineering, Faculty of Technology, Marmara University, Turkey

[4]Department of Nutrition and Dietetics, Gazi University, Turkey

ABSTRACT

Nowadays, the tendency to use natural and functional ingredients/products in food and pharmaceutical technologies has increased. One of the prominent products is propolis. Propolis is a resinous product obtained by honey bees from different parts of plant sources and mixed with beeswax. Propolis is a widely researched bioactive product in the treatment and prevention of chronic diseases and encapsulation technology is a potential method to protect bioactive components and develop new formulations with advanced properties. Propolis-loaded polymeric nanoparticles have been shown to stabilize the phenolic compounds found in propolis, protecting them from degradation due to pH changes or ionic strains. These nanoparticles have also been shown to improve the bioavailability of encapsulated propolis by 50% compared to free propolis. Until today, 300 compounds with potential bioactivity have been reported in propolis, including esters, phenolic acids, and flavonoids which has potential antibacterial, antifungal, anti-inflammatory, cardio-protective, antioxidant, antiviral, wound healing, and also anticancer activities. Therefore, it is extremely important to design new, natural and effective medicines. Within the scope of our study, it is aimed to develop bioactive substance-loaded micro/nano materials which has antimicrobial activity and has an important place in traditional and complementary medicine practices.

In this study the release behavior of a novel nanofiber-in-nanoparticle delivery system consisting of propolis extract (PE) loaded polylactic acid (PLA) nanoparticles embedded in polyvinyl alcohol (PVA) nanofiber mats will be investigated. As advanced strategy for drug release, the dual-step release (or biphasic release) offers benefits such as providing rapid therapeutic effects and maintaining a steady blood drug concentration over an extended duration, enhancing convenience for patients. In the study, optimum conditions were set and PLA/PE microparticles were prepared with a optimized ratio of by Electrohydrodynamic atomization (EHDA) /electrospraying method. These microparticles were used to load the optimized formulation and had a diameter of 5 ± 1 µm. Likewise, PVA nanofibers were prepared with different ratios of PE-loaded microparticles by electrospinning method. After the most suitable PE-loaded PLA microparticles embedded in nanofiber mat, characterization studies were done with SEM, FTIR etc., were applied for the morphological, mechanical and chemical evaluations of the nanofiber mats. The findings is planned to handled that embedding microparticles into nanofibers would provide long-term release. Moreover, in vitro analysis results showed that the designed nanoplatform has strong antimicrobial properties and and it is thought that it will take its place as an innovative nanomedicine application in many health applications as a technology that increases the effects of propolis and reduces side effects through multi-target therapy in future studies.

3D-Printed Scaffolds for Osteoporotic Bone Restoration based on Poly-ε-Caprolactone and Strontium-Doped Hydroxyapatite

Cosmin Iulian Codrea[1,2], Daniel Lincu[1,2], Irina Atkinson[2], Alexa Maria Croitoru[1,3], Bogdan Stefan Vasile[3,4,5], Adrian Ionut, Nicoară[1,3,4], Vladimir Lucian Ene[1,3,4, *], Miruna Silvia Stan[6], and Anton Ficai[1,3,4,5]

[1]UNST Politehnica of Bucharest, 011061 Bucharest, Romania

[2]Institute of Physical Chemistry "Ilie Murgulescu", 060021 Bucharest, Romania

[3]National Centre for Food Safety, UNST Politehnica of Bucharest, 060042 Bucharest, Romania

[4]National Research Center for Micro and Nanomaterials, UNST Politehnica of Bucharest, 060042 Bucharest.

[5]Academy of Romanian Scientists, 3 Ilfov Street, Bucharest, Romania

[6]University of Bucharest, Splaiul Independentei 91-95, 050095 Bucharest, Romania

*Correspondence: vladimir.ene@upb.com

ABSTRACT

Developing bone scaffolds that promote bone regeneration together with controlled local drug delivery is a challenge in tissue engineering and an active research area. Strontium (Sr) is an effective anti-osteoporotic agent that treats osteoporosis through anti-resorptive and anabolic mechanisms but systemic administration can cause important side effects, especially regarding the cardiovascular system[1]. In this study, we created multi-layer 3D composite scaffolds for bone tissue restoration using nanohydroxyapatite (HA), strontium-containing nanohydroxyapatite (SrHA), and poly-ε-caprolactone (PCL) through material extrusion 3D printing[2]. Previously obtained HA and SrHA powders with varying Sr content were used. Powder sinthesys was conducted through co-precipitation and hidrothermal methods. The HA/SrHA powders synthesized via the simple and cost-effective co-precipitation method more closely resembles the physicochemical properties of bone mineral. It exhibits lower crystallinity as well as carbonate substitutions, which are characteristic of natural bone mineral[3]. The 3D-printed HA/SrHA/PCL scaffolds were analyzed for their chemical, morphological, mechanical, and biocompatibility properties. The 3D composite scaffolds demonstrated good cytocompatibility and osteogenic potential, making them suitable for applications requiring faster mineralization, such as osteoporosis treatment. Based on the cell viability, quantitative cell adhesion analysis, and mechanical property assessments, samples containing SrHA with a lower Sr concentration are more suitable for bone tissue applications. Additionally, when comparing the overall results between the scaffolds containing HA/SrHA synthesized through the two different methods, the co-precipitation method is recommended for producing these composite scaffolds.

References

1. Codrea, C.I.; Croitoru, A.-M.; Baciu, C.C.; Melinescu, A.; Ficai, D.; Fruth, V.; Ficai, A. Advances in Osteoporotic Bone Tissue Engineering. *J. Clin. Med.* **2021**, *10*, 253. https://doi.org/10.3390/jcm10020253;
2. Codrea, C.I.; Lincu, D.; Ene, V.L.; Nicoară, A.I.; Stan, M.S.; Ficai, D.; Ficai, A. Three-Dimensional-Printed Composite Scaffolds Containing Poly-ε-Caprolactone and Strontium-Doped Hydroxyapatite for Osteoporotic Bone Restoration. *Polymers* **2024**, *16*, 1511. https://doi.org/10.3390/polym16111511;
3. Codrea, C.I.; Lincu, D.; Atkinson, I.; Culita, D.C.; Croitoru, A.-M.; Dolete, G.; Trusca, R.; Vasile, B.S.; Stan, M.S.; Ficai, D.; et al. Comparison between Two Different Synthesis Methods of Strontium-Doped Hydroxyapatite Designed for Osteoporotic Bone Restoration. *Materials* **2024**, *17*, 1472. https://doi.org/10.3390/ma17071472

Design and Characterization of a Wound Dressing Using Beta-Glucan and Zinc Oxide Nanoparticles via Electrospinning Method

Derya Çelik[1], Yunus Emre Kul[1], Cem Bülent Üstündağ[1]

[1]Yıldız Technical University, 34220 Istanbul, TURKEY
*Correspondence: cbustundag@gmail.com

ABSTRACT

Wound dressings help to speed up healing with extracellular matrix and by shielding wounds from the environment, lowering the risk of infection, and preserving moisture balance. They contribute significantly to wound care by giving patients a convenient and comfortable experience along with mechanisms that stimulate healing. The first inflammatory response to the maturation of the extracellular matrix are the three crucial phases of wound healing that are covered in this project.[1] Our goal is to create a wound dressing with beta-glucan, a naturally occurring polysaccharide that is advantageous because it comes from plant and fungal cell walls. Researches show that beta-glucan promotes tissue repair, boosts immune response, and has antibacterial and antioxidant qualities, all of which have a positive effect on wound healing.[2] More clinical studies are necessary to validate its effectiveness in wound healing, though.

The sustainable natural material known as *hericium erinaceus* mushroom will be used to produce beta-glucan. Zinc oxide nanoparticles, which are recognized for their antimicrobial, anti-inflammatory, and wound-healing qualities. Zinc oxide prepared using the leftover liquid waste from the beta-glucan extraction process. Zinc oxide shields the wound from the environment and stimulate the growth of skin cells, granulation tissue, and moisture balance.[3] The goal of this project is to create a wound dressing by electrospinning these two materials together with PVA. The combined effects of beta-glucan and zinc oxide will be thoroughly characterized and investigated. The expected results of the project will contribute to the literature by providing an early analysis of new research in the healthcare sector.

References

1. Britto, E. J., Nezwek, T. A., Popowicz, P., & Robins, M. (2024, January 23). Wound Dressings. Retrieved May 24, 2024, from Nih.gov website: https://www.ncbi.nlm.nih.gov/books/NBK470199/
2. Feng, T., Shui, M., Chen, Z., Zhuang, H., Wang, W., Yang, Y., … Ye, R. (2019). Hericium Erinaceus β-glucan modulates in vitro wheat starch digestibility. *Food Hydrocolloids*, *96*, 424–432. https://doi.org/10.1016/j.foodhyd.2019.05.044
3. Banerjee, K., Radha Madhyastha, Nakajima, Y., Maruyama, M., & Harishkumar Madhyastha. (2021). Nanoceutical Adjuvants as Wound Healing Material: Precepts and Prospects. *International Journal of Molecular Sciences*, *22*(9), 4748–4748. https://doi.org/10.3390/ijms22094748

Biogenically synthesized zinc oxide nanoparticles: A promising paradigm for effective therapy

Devi-Nair Gunasegavan Rathi[1,2], Norhaizan Mohd Esa[3] and Che Azurahanim Che Abdullah[1,4*]

[1]Nanomaterial Synthesis and Characterization Lab, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

[2]Nutrition, Metabolic and Cardiovascular Research Centre, Institute for Medical Research, National Institute of Health, Ministry of Health Malaysia, Setia Alam, 40170 Shah Alam, Selangor, Malaysia

[3]Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

[4]Biophysics Lab, Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

*Correspondence: azurahanim@upm.edu.my

ABSTRACT

Nanotechnology has emerged as a promising field with numerous applications, such as the eco-friendly synthesis of nanoparticles (NPs) using medicinal plants. These medicinal plants has been identified to be an enriched source of phenols, sterols, flavonoids, fatty acids, tocopherols and pigments. These contents have been associated with their potential as anticancer, anti-inflammatory, antioxidants, anti-diabetic agents and other properties. However, these compounds' limited stability, solubility and bioavailability hinder their effective application. In this study, we aimed to biogenically synthesize zinc oxide nanoparticles (ZnONPs) using aqueous plant extract that will be evaluated for its potential as an anti-diabetic agent. Several parameters were controlled using the Taguchi model for the ZnONPs synthesis, which includes the temperature, pH, precursor concentration and also the extract volume. The most optimal condition for the synthesis was determined by the absorbance and particle size measurement of the obtained ZnONPs. Based on the Taguchi analysis, the most optimal condition was determined and two representative samples were selected for further characterization. In general, the synthesized ZnONPs ranged between 100 – 300 nm, respective to the combination of various parameters. The selected samples that were subjected to Field-emission scanning electron microscopy analysis indicated a mixture of both spherical and irregular-shaped particles. In terms of energy-dispersive X-ray spectroscopy analysis, all analyzed samples showed the presence of carbon, oxygen and zinc elements, which indicated the successful formation of zinc oxides. Further characterizations are being conducted for a more comprehensive finding and optimization of the synthesized NPs properties. The optimal formulation will be subjected for in vitro assays to evaluate its potential as an anti-diabetic agent, bioavailability and toxicity. Overall, this research is expected to highlight the potential biomedical applications of the biogenic ZnONPs.

References

1. Zolkepli H, Widodo RT, Mahmood S, Salim N, Awang K, Ahmad N, Othman R. A Review on the Delivery of Plant-Based Antidiabetic Agents Using Nanocarriers: Current Status and Their Role in

Combatting Hyperglycaemia. Polymers (Basel). 2022 Jul 24;14(15):2991. doi: 10.3390/polym14152991.

2. Sharma, A., Bachheti, A., Sharma, P., Bachheti, R. K., & Husen, A. (2020). Phytochemistry, pharmacological activities, nanoparticle fabrication, commercial products and waste utilization of Carica papaya L.: A comprehensive review. Current Research in Biotechnology, 2, 145-160.

3. Brindha, D., Santhi, R., Aparna Pragadeaswari, K., & Valarmathi, R. (2018). Antioxidant, free radical scavenging and antibacterial potential of biosynthesized zinc oxide nanoparticles of Carica papaya seeds. International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: Volume 6 Issue IV, April 2018-Available at, 6(IV), 3011-3017.

Fire Reaction Performance of Nanosilica-Treated Wood: A Study of Various Fire Testing Methods

Diana Talau[1], Anton Ficai[1,2,3]

[1]National University of Science and Technology POLITEHNICA Bucharest, 011061 Bucharest, Romania

[2]National Research Center for Micro and Nanomaterials, National University of Science and Technology POLITEHNICA Bucharest, 060042 Bucharest, Romania

[3]Academy of Romanian Scientists, 3 Ilfov Street, Bucharest, Romania

*Correspondence: diana.talau@stud.chimie.upb.ro

ABSTRACT

The impregnation of wood with nanosilica particles presents a promising strategy for enhancing the fire retardant properties of wood, particularly in applications like construction. Nanosilica incorporation into wood structures has been shown to improve various properties such as flame retardancy, UV stabilization, dimensional stability, and resistance against fungi. While previous research has primarily focused on testing the fire properties of wood treated with inorganic composites using thermal analysis methods like TGA and DTA, these techniques offer valuable insights into the thermal attributes of materials but may not fully capture the fire properties of large-scale samples in diverse fire scenarios.

To address this gap, the current study aims to investigate various fire testing methods for wood impregnated with nanosilica. This research builds upon existing knowledge on the use of nano-scale fire retardants, such as nanocomposite coatings, to enhance the fire resistance of wood. By exploring different fire testing methods, this study seeks to provide a comprehensive understanding of how nanosilica-treated wood performs in various fire situations. Additionally, the study may benefit from considering the effectiveness of combining nannosilica particles with different fire-retardant chemicals, such as phosphorus and phytic acid.

References

1. Mahr, M. S., Hübert, T., Schartel, B., Bahr, H., Sabel, M., & Militz, H. (2012). Fire retardancy effects in single and double layered sol–gel derived tio2 and sio2-wood composites. Journal of Sol-Gel Science and Technology, 64(2), 452-464. https://doi.org/10.1007/s10971-012-2877-5
2. Zhu, X., Tian, C., Qing, Y., & Yao, C. (2014). Synergistic effect of nanosilica aerogel with phosphorus flame retardants on improving flame retardancy and leaching resistance of wood. Journal of Nanomaterials, 2014, 1-8. https://doi.org/10.1155/2014/867106
3. Chen, Z., Zhang, S., Ding, M., Wang, M., & Xu, X. (2021). Construction of a phytic acid–silica system in wood for highly efficient flame retardancy and smoke suppression. Materials, 14(15), 4164. https://doi.org/10.3390/ma14154164

DEVELOPMENT OF NANOBODY-CONJUGATED POLYETHYLENEIMINE POLYMERIC NANOPARTICLES FOR TARGETED THERAPY

Dilara Zalim[1,2], Rabia Çakır[1,3*], Lara González-Cabaleiro[2], Lorena Vázquez-Iglesias[2], Isabel Pastoriza-Santos[2] and Gustavo Bodelón[2*]

[1]Yildiz Technical University, Istanbul, Turkey
[2]CINBIO, Universidade de Vigo, Vigo, Spain
[3]Health Institutes of Turkey (TUSEB), Turkey Biotechnology Institute, Istanbul, Turkey

*Correspondence: rabiacakir@gmail.com, gbodelon@uvigo.es

ABSTRACT

Targeted delivery of therapeutical drugs and nanomedicines is critical for the safety and efficiency treatment of cancer and other malignancies. Over the past years, the use of NPs has increased exponentially, especially in cancer treatment, due to their ability to perform high-precision tasks, such as the direct delivery of drugs and imaging contrast agents directly to tumor cells by using a large number of molecular targeting ligands [1]. A common approach is to functionalize nanoparticles NPs with antibodies that specifically bind to their targets in order to enhance their therapeutic efficacy [2].

Herein, an approach for the bioconjugation of maltose modified polyethyleneimine (PEI) NPs (PEI@maltose) with a nanobody (Nb) to realize specific binding to cell surface biomarkers is presented. This functionalization strategy is based on the affinity between maltose and a chimeric protein consisiting on the maltose binding protein (MBP) genetically fused to a nanobody that recognizes the epidermal growth factor receptor (Nb_{EGFR}). In addition, aiming to optically monitor the binding to cells by fluorescence microscopy, the fluorescence emission of the NPs was enhanced by their functionalization with fluorescein-5-isothiocyanate (FITC).

The synthesis of PEI@maltose@FITC@MBP-Nb_{EGFR} NPs was characterized by UV-Vis, DLS, Zeta potential, TEM and fluorescence spectroscopy. The bioconjugation of MBP-Nb_{EGFR} polypeptide to PEI@maltose@FITC was demonstrated by gel electrophoresis. Binding of the NPs to the A431 tumor cell line that overexpresseses EGFR was evaluated in vitro by fluorescence microscopy.

The results demonstrated the successful bioconjugation of the polymeric NPs with the MBP-Nb_{EGFR} polypeptide, as well as their binding to A431 cells. Additional studies are underway to confirm whether the observed binding is mediated by the recombinant antibody. If the specific binding to the EGFR cell surface protein is demonstrated, it is envisage that the reported approach could be a valuable method for targeted therapy based on PEI nanoparticles.

References

1. J. Yoo, C. Park, G. Yi, D. Lee, and H. Koo, “Active Targeting Strategies Using Biological Ligands for Nanoparticle Drug Delivery Systems,” *Cancers*, vol. 11, no. 5, pp. 640–640, May 2019, doi: https://doi.org/10.3390/cancers11050640.
2. M. Kumari, A. Acharya, and Praveen Thaggikuppe Krishnamurthy, “Antibody-conjugated nanoparticles for target-specific drug delivery of chemotherapeutics,” *Beilstein journal of nanotechnology*, vol. 14, pp. 912–926, Sep. 2023, doi: https://doi.org/10.3762/bjnano.14.75.

Analysis of Oxycodone Hydrochloride as an Opiod Analgesic

Elena Christen Creangă[1,2]

[1]University Politehnica of Bucharest, 011061 Bucharest, Romania
[2]Academy of Romanian Scientists, 3 Ilfov Street, Bucharest, Romania
[3]National Research Center for Micro and Nanomaterials, University Politehnica of Bucharest, 060042 Bucharest, Romania
*Correspondence: elena.creanga@stud.chimie.upb.ro, elena.creanga@stud.umfcd.ro

ABSTRACT

Oxycodone hydrochloride is a semi-synthetic opioid that is primarily used for pain treatment. The European Pharmacopoeia includes the drug description, formulation, main chemical properties, chemical tests used to determine identity and dosage standards. Misuse and illegal drug use are becoming a major concern for authorities worldwide. Because of this, the detection and monitoring of opioids from biological samples is a problem that needs to be updated. Nanoparticulates are considered suitable tools for monitoring opioids present in biological samples. Noble metal nanoparticles, such as gold and silver, are the primary ones used, along with carbon nanotubes. Nanoparticles are included in biosensors or nanobiosensors that are extremely sensitive to the detection limit of opioids. Signals emitted by nanobiosensors immobilize the biological molecules of interest on their surfaces. The present work focuses on the pharmacological characterization of oxycodone hydrochloride, as well as the use of nanobiosensors for detecting the opiod.

References

1. *Oxycodone hydrochloride*, Ph.Eur. Ed. 11.2, 01/2008:1793 corrected 7.0: 3608-3609.
2. A. Gallego, M. Baron, E. Arranz, "Oxycodone: a pharmacological and clinical review", Clinical Transl Oncol, 2007, 298-307.
3. F. Karnak, M. Kahrizi, S. Mirinejad, S. Sargazi, S. Mishra, A. Rahdar, A. Pascual, "Nanobiosensors for detection of opiods: A review of latest advancements", European Journal of Pharmaceutics and Biopharmaceutics, Vol. 179, 2022, 79-94.
4. F. Mousazadeh, Y.Baghelan, S. Rahimi, "Recent advances in nanomaterials-based electrochemical sensors for tramadol analysis", ADMET DMPK, 2023, Vol.11, 117-134.

YSZ-Based Scaffolds Infiltrated with Nanohydroxiapatite and Silver Nanoparticles Biopolymeric Composites for Bone Regeneration Applications

Ernesto J. Delgado-Pujol [1, *], Gemma Fargas [2,3], Victoria Axelrad [4], Guillermo Martinez, Gemma Herranz [4], Belén Begines [5], Cristina Berges [4], Luis Llanes [2,3], Ana Alcudia [5], Yadir Torres [1].

[1] Departamento de Ingeniería y Ciencia de los Materiales y del Transporte, Escuela Politécnica Superior, Universidad de Sevilla, 41011, Seville, Spain.

[2] Departamento de Ciencia e Ingeniería de Materiales, Universidad Politécnica de Cataluña, 08019, Barcelona, Spain.

[3] Centro de Investigación en Ciencia e Ingeniería Multiescala de Barcelona, Universidad Politécnica de Cataluña, 08019, Barcelona, Spain.

[4] INEI-Escuela Técnica Superior de Ingeniería Industrial, Universidad de Castilla– La Mancha, 13071, Ciudad Real, Spain.

[5] Departamento de Química Orgánica y Farmacéutica, Facultad de Farmacia, Universidad de Sevilla, 41012, Seville, Spain.

*Correspondence: edelgado4@us.es

The impact of fracture and bone defects has been a main motivation for research initiatives aiming to improve quality of life for patients. Addressing these problems is crucial, thus it is important to recognise the complexities inherent in this field of research [1]. Where each patient presents a unique clinical scenario, in addition to the difficulties associated with reproducing the properties and intricate design of natural bone. This study focuses on the development and optimisation of scaffolds manufactured using 3D printing techniques, specifically using ceramic materials such as yttria-stabilised zirconia, known for its excellent biocompatibility and mechanical properties [2, 3]. Various scaffolds designed for specific medical situations, improving their suitability for in vivo applications by infiltrating biopolymers. The first case study aims to improve the antimicrobial activity of the scaffolds by incorporating silver nanoparticles (AgNPs) into the composite. Silver nanoparticles are known for their potent antimicrobial properties, which can significantly reduce the risk of infection after implantation [4, 5]. The second approach focuses on improving the osseointegration capacity of scaffolds through the addition of nanohydroxyapatite (nHA). Nanohydroxyapatite closely mimics the mineral component of bone, which promotes better integration and stability in the biological environment [6, 7]. The infiltrated samples were subjected to evaluations, including assessment of polymer degradation within the composite to understand the longevity and performance of the scaffolds over time. Uniaxial compression tests were conducted to measure the mechanical strength and elasticity of the scaffolds, ensuring they meet the standards required for medical applications. In addition, the bioactivity of the scaffolds was assessed through studies of the ability to form apatite on the surface, using X-ray diffraction (XRD) to confirm the presence and quality of apatite, which is indicative of the scaffold's ability to support bone regeneration. The results demonstrate improvements in

both antimicrobial activity and osseointegration capacity, suggesting that these composite scaffolds hold great promise for future clinical applications. By integrating advanced materials and innovative design techniques, this research contributes to the development of more effective and reliable solutions for bone repair and regeneration, with the final goal of improving patient outcomes and quality of life. The results underline the potential of these advanced scaffolds to address critical challenges in the field of biomaterials engineering, paving the way for future innovations in medical treatments.

Keywords: biopolymer; osteointegration; silver nanoparticles; antimicrobial activity; scaffold.

References

1 Nauth, M. D. McKee, T. A. Einhorn, J. T. Watson, R. Li, and E. H. Schemitsch, "Managing bone defects," *Journal of orthopaedic trauma,* vol. 25, no. 8, pp. 462-466, 2011, doi: https://doi.org/10.1097/BOT.0b013e318224caf0.

2 G. Herranz *et al.*, "Design and Manufacturing by Fused Filament Technique of Novel YSZ Porous Grafts Infiltrated with PCL/PVA/AgNPS for Large Bone Defects Repairing," *PVA/AgNPS for Large Bone Defects Repairing*, doi: https://dx.doi.org/10.2139/ssrn.4650264

3 L. u. Hodásová *et al.*, "Polymer infiltrated ceramic networks with biocompatible adhesive and 3D-printed highly porous scaffolds," *Additive Manufacturing,* vol. 39, p. 101850, 2021, doi: https://doi.org/10.1016/j.addma.2021.101850.

4 J. Delgado-Pujol *et al.*, "Porous beta titanium alloy coated with a therapeutic biopolymeric composite to improve tribomechanical and biofunctional balance," *Materials Chemistry and Physics*, vol. 300, p. 127559, 2023/05/01/ 2023, doi: https://doi.org/10.1016/j.matchemphys.2023.127559.

5 Alcudia *et al.*, "Development of porous silver nanoparticle/polycaprolactone/polyvinyl alcohol coatings for prophylaxis in titanium interconnected samples for dental implants," *Colloid and Interface Science Communications*, vol. 48, p. 100621, 2022/05/01/ 2022, doi: https://doi.org/10.1016/j.colcom.2022.100621.

6 Zadpoor, "Relationship between in vitro apatite-forming ability measured using simulated body fluid and in vivo bioactivity of biomaterials," *Materials Science and Engineering: C,* vol. 35, pp. 134-143, 2014/02/01/ 2014, doi: https://doi.org/10.1016/j.msec.2013.10.026.

7 T. Albrektsson and C. Johansson, "Osteoinduction, osteoconduction and osseointegration," *European Spine Journal,* vol. 10, no. 2, pp. S96-S101, 2001/10/01 2001, doi: https://doi.org/10.1007/s005860100282.

The Role of 3D-Printing Technologies in Oncology – A Comprehensive Study Among Medical Students

Eugeniu Valic[1*], Vladimir Valic[2], Daniela Ciobanu[1], Ion Mereuță[1,3,4], Grzegorz Bielęda[5,6]

[1]„*Nicolae Testemițanu*" State University of Medicine and Pharmacy of Republic of Moldova, 2004 Chișinău, Republic of Moldova

[2]„*Bogdan Petriceicu Hașdeu*" State University, 3909 Cahul, Republic of Moldova

[3]Physiology and Sanocreatology Institute, State University of Moldova, 2028 Chișinău, Republic of Moldova

[4]„*Gheorghe Țîbîrnă*" Academy of Medical Sciences of Republic of Moldova, 2019 Chișinău, Republic of Moldova

[5]Electroradiology Department, Poznan University of Medical Sciences, 61-701 Poznań, Poland

[6]Medical Physics Department, Greater Poland Cancer Centre, 61-866 Poznań, Poland

*Correspondence: eugeniu.valic.jr@gmail.com

ABSTRACT

The 3D-printing technologies (3D-PT) are considered as a game-changing way of manufacturing a variety of objects and products with a computer-guided precision. They are used nowadays in various domains, especially in the oncology field. With the development of new diagnostic and treatment methods in oncology, 3D-PT have proved their role in different areas of cancer management, being an innovative way of modeling and creating personalized applicators, prostheses and interactive 3D-printed models of patients' tumors for both educational and treatment purposes.

Aim of study: Assessment of the level of knowledge and attitudes among medical students who have already completed an oncology module about the role of 3D-printing technologies (3D-PT) in oncology and their implementation in the studying process.

Methods and materials: A descriptive cross-sectional study was conducted in the period of May 2023- September 2023 with the participation of 158 students, including 140 students of the Vth year from Medicine nr.1 faculty of Nicolae Testemitanu SUMPh who have already completed Oncology module during the year of study 2022-2023 and 18 students from 12 countries (Azerbaijan, Bulgaria, Croatia, Georgia, Germany, Latvia, Northern Macedonia, Pakistan, Poland, Romania, Turkey and Ukraine)-participants of ESO-ESSO-ESTRO-SIOPE Multidisciplinary Course in Oncology for Medical Students 2023 in Poznan, Poland, who have already completed Oncology module as of September 2023. The respondents were invited to fill in an online questionnaire to collect data about their knowledge and attitudes related to the role of 3D-printing technologies in oncology.

Results: Of the total number of participants (N=158), 119 were female (75,3%) and 39 were male (24,7%), median age- 24,5 years. The majority of the students (147 students, 93%) have heard about 3D-PT, 103 of them (65,2%) appreciated their knowledge about them as low and 48 (30,4%) as moderate. Only 29 students (18%) used a 3D-printed object. 110 students (70% of respondents) considered the use of 3D-PT in oncology as highly necessary. The possible management of cancer types with 3D-PT were bone (34,2%), breast (26,6%) and lung (17%) cancers. Of the possible directions for the implementation of 3D-PT in oncology, 22,1% responded for diagnosis, 25,3% preoperative management, 29,7% postoperative management, 36,7% educational, and 34,8% research. A majority of 98% considered the possibility of exposing the data from imaging investigations in the 3D-printed version as highly necessary and necessary. Moreover, 82% stated that 3D-PT would have a high impact in improving the quality of studies with the introduction of them in the studying process at the Oncology module.

Conclusion: The majority of the students who responded considered that 3D-PT would have an important role in the improvement of the studying process at Oncology module as well as a potential role in the development of personalized treatment of cancer patients.

Key words: Oncology, medical students, cancer, 3D printing, personalized medicine.

Comparative Effect of Unmodified and Surface-Modified Nanocellulose on the Characteristics of Nanoemulsions

Gabriela – Mădălina Oprică[1,2]*, Cătălina – Diana Uşurelu[1,2], Adriana Nicoleta Frone[2], Cristina Firincă[2], Cristian – Andi Nicolae[2], Radu Claudiu Fierăscu[1,2], Denis Mihaela Panaitescu[2]

[1]Politehnica Bucureşti National University for Science and Technology, 011061 Bucharest, Romania
[2]National Institute for Research and Development in Chemistry and Petrochemistry – ICECHIM, Bucharest, Romania
*madalina.oprica@icechim.ro

ABSTRACT

Nanocellulose emerged as an alternative to conventional emulsion stabilizers due to its distinctive properties and biocompatibility. Nanocellulose is obtained from renewable sources (wood pulp, cotton, agricultural waste) and has valuable characteristics such as a high surface area, amphiphilic nature, and capacity to prevent the coalescence of the emulsions, which make it appropriate for use in nanoemulsions [1,2]. Nanoemulsions are an appealing product of the pharmaceutical and cosmetics industries and proved to act as excellent drug carrier systems. In this context, the lack of toxicity of nanocellulose and the other ingredients is a highly desirable attribute. In addition, the presence of the hydroxyl groups on its surface allows for chemical modification that makes possible further tailoring of amphiphilic properties.

In this work, nanocellulose and 2,2,6,6,tetramethylpiperidine-1-oxyl (TEMPO) oxidized nanocellulose were used as stabilizers in nanoemulsions designed as antibacterial drug-delivery systems. Diferuloyl methane (curcumin), which is the active compound in *Curcuma longa*, is well-known for its antibacterial and anti-inflammatory properties and was used in this work as a drug in the nanocellulose-stabilized nanoemulsions. The bioavailability of curcumin can be enhanced by incorporating it in emulsions or nanoemulsions, where its solubility can be increased for better cutaneous absorption. The influence of the surface treatment of nanocellulose on the properties of nanoemulsions was studied in this work by droplet size distribution, stability in time, optical microscopy, and antibacterial tests. The results showed that nanocellulose-stabilized nanoemulsions are promising drug delivery systems.

References

1. Uşurelu, C., Frone, A. N., Oprică, G., Raduly, M. F., Ghiurea, M., Neblea, E. I., Nicolae, C., Filip, X., Teodorescu, M., & Panaitescu, D. M. (2024). Preparation and functionalization of cellulose nanofibers using a naturally occurring acid and their application in stabilizing linseed oil/water Pickering emulsions. International Journal of Biological Macromolecules, 262, 129884. https://doi.org/10.1016/j.ijbiomac.2024.129884

2. Aw, Y. Z., Lim, H. P., Low, L. E., Surjit Singh, C. K., Chan, E. S., & Tey, B. T. (2022). Cellulose nanocrystal (CNC)-stabilized Pickering emulsion for improved curcumin storage stability. LWT, 159, 113249. https://doi.org/10.1016/j.lwt.2022.113249

Acknowledgment

This work was financially supported by a grant of the Ministry of Research, Innovation and Digitalization – UEFISCDI, project number PN-III-P2-2.1-PED-2021-2559 (BIOPLASM)

Efficient Removal of Anionic Dye and Pharmaceutical Drugs from Wastewaters by Copper-Modified Hemp Fibers

Gianluca Viscusi[1,*], Elena Lamberti[1], Giuliana Gorrasi[1]

[1] Department of Industrial Engineering, University of Salerno, Via Giovanni Paolo II, 132, 84084, Fisciano, Italy, *Correspondence: gviscusi@unisa.it

ABSTRACT

Water pollution is regarded as a dangerous problem that must be resolved immediately. Among the pollutants, dyes and emerging anti-inflammatory drugs have received widespread concern [1]. The use of synthetic adsorbents is limited due to their high cost and regeneration. So, using novel green adsorbents allows for removing different pollutants from wastewater [2]. This work concerns the use of aluminium-functionalized hemp fibres modified with copper to remove methyl orange (MO) and different pharmaceutical compounds such as diclofenac sodium salt (DSS) and piroxicam (PX). Characterization of the as-prepared adsorbent was carried out via SEM, EDX, FTIR, XRD, TGA, and zeta potential analysis. Firstly, the adsorption capacity of Cu-modified hemp fibres was compared with raw hemp fibres. Then, parameters such as contact time, pH (2-12), temperature (20-80°C), initial concentration of dye c_0 (50-300 ppm), and adsorbent dosage (1-10 g/L) were varied and their effects on the adsorption recovery of methyl orange were evaluated. The data proved that the adsorption kinetics reached equilibrium within 20 minutes for MO and 4-5 hours for DSS and PX. The dye adsorption is concentration dependent while an acidic medium favoured the removal of anionic dye. The adsorption efficiency of MO is 99.8% (T room and c_0=50 ppm). The experimental kinetic data were fitted through pseudo-first order, pseudo-second order and intraparticle diffusion models. The co-existence of physisorption and chemisorption is thus established for the adsorption of different pollutants. Besides, different isotherm models have been adopted (Langmuir, Freundlich, Temkin). Among all, the Langmuir model well fitted the adsorption data with a q_m=338.98 mg/g. Thermodynamic calculation proved that the adsorption process is spontaneous (negative ΔG) and endo-thermic. Moreover, the produced adsorbent showed high selectivity and great performance in removing anti-inflammatory drugs (initial concentration 10 ppm) showing a removal efficiency of about 99% for PX and about 49 % for DSS. Re-usability cycles proved the efficiency of the designed bio-adsorbent. Besides, the adsorption capacity of the designed adsorbent has been evaluated by analysing the simultaneous removal of MO, DSS and PX. So, it is demonstrated the adsorption efficiency of a novel, inexpensive, and sustainable composite material obtained from agro-waste resources which can be used in real-life wastewater treatment applications.

References

1. Viscusi, G., Lamberti, E., & Gorrasi, G. (2021). Hemp fibers modified with graphite oxide as green and efficient solution for water remediation: Application to methylene blue. Chemosphere, 132614. https://doi.org/10.1016/J.CHEMOSPHERE.2021.132614

2. Anjum, A., Mazari, S. A., Hashmi, Z., Jatoi, A. S., Abro, R., Bhutto, A. W., Mubarak, N. M., Dehghani, M. H., Karri, R. R., Mahvi, A. H., & Nasseri, S. (2023). A review of novel green adsorbents as a sustainable alternative for the remediation of chromium (VI) from water environments. Heliyon, 9(5), e15575. https://doi.org/10.1016/J.HELIYON.2023.E15575

Bioactive and Biodegradable Hydrogels for Improving Biofunctional Performance of Titanium Implants

Guillermo Martínez[1,*], Ernesto Delgado-Pujol[1,2], David Casado[1], Juan Vázquez[3], Luisa Marleny Rodríguez-Albelo[1], Belén Begines[1], Eloísa Pajuelo[4], Yadir Torres[2], Ana Alcudia[1]

[1] Departamento de Química Orgánica y Farmacéutica, Facultad de Farmacia, Universidad de Sevilla, Seville 41012, Spain

[2] Departamento de Ingeniería y Ciencia de los Materiales y del Transporte, Escuela Politécnica Superior, Universidad de Sevilla, Seville 41011, Spain

[3] Departamento de Química Orgánica, Facultad de Química, Universidad de Sevilla, Seville 41004, Spain

[4] Departamento de Microbiología y Parasitología, Facultad de Farmacia, Universidad de Sevilla, Seville 41012, Spain

*Correspondence: gmartinez1@us.es

ABSTRACT

With increased life expectancy, the durability of human organs and systems remains a major health issue. The medical industry has developed numerous implants and prostheses to restore organ functionality and improve patient quality of life. Titanium and its alloys are commonly used for their biocompatibility and corrosion resistance, but they face problems such as stress shielding, potential toxicity, bacterial infections, and poor osseointegration, which can compromise long-term performance (1). This research proposes a synergistic approach to address these challenges.

On the one hand, the implementation of porous titanium (Ti) implants offers a potential solution to reduce the stress-shielding phenomenon, by using space-holder materials has allowed for adjustable porosity, uniform pore shape, and size distribution, addressing traditional challenges (2). However, Ti-based implants still need improvements in osseointegration and antibacterial performance to enhance bioactivity. On the other hand, hydrogels are emerging as innovative materials ideal for tissue mimicking, tissue engineering, and bone regeneration (3). Hydrogels can promote cell adhesion and proliferation by mimicking the tissue environment and can be functionalized with peptides and biomolecules. Poly(acrylic acid) is a notable example, used for its biodegradability, non-toxicity, and high versatility in biomedical applications (4).

In this work, a double-sided approach was developed to enhance implant performance by using porous titanium (Ti) substrates and a biodegradable, acrylic acid-based polymeric coating. This method aims to reduce the mismatch between the Young's modulus of Ti (around 110 GPa) and cortical bone (20–25 GPa) and to decrease bacterial adhesion and proliferation while improving osseointegration. Porous commercially pure Ti substrates with varying porosities and pore sizes were fabricated using space-holder techniques, resulting in improved tribomechanical behavior. Additionally, a new diacrylate cross-linker with a reduction-sensitive disulfide bond was synthesized to create biodegradable poly(acrylic acid)-based hydrogels with 1, 2, and 4% cross-linker. After thorough characterization, the combination of a 4% cross-

linked poly(acrylic acid)-based hydrogel infiltrated into Ti substrates with 30% porosity and 100–200 μm average pore size was identified as an excellent option for enhancing implant performance.

References

1. Gaviria, J.; Alcudia, A.; Begines, B.; Beltrán, A. M.; Rodríguez-Ortiz, J. A.; Trueba, P.; Villarraga, J.; Torres, Y. Biofunctionalization of Porous Ti Substrates Coated with Ag Nanoparticles for Potential Antibacterial Behavior. *Metals* **2021**, *11* (5), 692, DOI: 10.3390/met11050692
2. Torres, Y.; Lascano, S.; Bris, J.; Pavón, J.; Rodriguez, J. A. Development of porous titanium for biomedical applications: A comparison between loose sintering and space-holder techniques. *Mater. Sci. Eng., C* **2014**, *37*, 148– 155, DOI: 10.1016/j.msec.2013.11.036 Reference
3. Spicer, C. D. Hydrogel scaffolds for tissue engineering: the importance of polymer choice. *Polym. Chem.* **2020**, *11* (2), 184– 219, DOI: 10.1039/C9PY01021A
4. Martínez, G.; Begines, B.; Pajuelo, E.; Vázquez, J.; Rodríguez-Albelo, L.M.; Cofini, D.; Torres, Y.; Alcudia, A. Versatile Biodegradable Poly(acrylic acid)-Based Hydrogels Infiltrated in Porous Titanium Implants to Improve the Biofunctional Performance. *Biomac.* **2023**, 24 (11), 4743-4758, DOI: 10.1021/acs.biomac.3c00532

In Vitro Characterization and Evaluation of 3D Printed Styrax Liquidus (Liquidambar orientalis Miller)-Loaded Poly (L-lactic acid)/Chitosan Based Wound Dressing Material

Hanife Yuksel Cakmak[1], Hasan Ege[2], Senanur Yilmaz[3,4], Gokhan Agturk[2], Fulya Dal Yontem[5,6], Gozde Enguven[3,4], Abdurrahman Sarmis[7], Zeren Cakmak[8], Oguzhan Gunduz[3,4], Zeynep Ruya Ege[3,9*]

[1] Bahcesehir University, School of Medicine, Istanbul, Turkey

[2] Department of Physiology, School of Medicine, Halic University, Istanbul, Turkey

[3] Center for Nanotechnology and Biomaterials Applied and Research, Marmara University, Istanbul, Turkey

[4] Department of Metallurgical and Materials Engineering, Faculty of Technology, Marmara University, Istanbul, Turkey

[5] Department of Biophysics, Koc University School of Medicine, Koç University, Sariyer, Istanbul, Turkey

[6] Koc University Research Center for Translational Medicine (KUTTAM), Sariyer, 34450 Istanbul, Turkey

[7] Department of Medical Microbiology Laboratory, Goztepe Prof. Dr. Suleyman Yalcin City Hospital, Istanbul, Turkey

[8] Kartal Prof. Dr. Saban Teoman Durali Science and Art Center, Istanbul, Turkey

[9] Department of Biomedical Engineering, Faculty of Engineering, Istanbul Arel University, Istanbul, Turkey

*Correspondence: zeynepruyaege@arel.edu.tr

ABSTRACT

Wound dressing materials are widely used to reinforce the healing process of chronic wounds. An ideal dressing is expected to have similar properties to the extracellular matrix. In this study, the medicinal plant of Styrax liquidus (ST) extracted from Liquidambar orientalis Miller tree, was loaded into 3D printed polylactic acid (PLA)/chitosan (CS) based scaffolds to investigate its wound healing and closure effect on human fibroblast cells.

The 3D printed scaffolds were prepared with different concentrations of ST (1 %, 2 %, and 3 % wt). The morphological and chemical properties were investigated by Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FT-IR), respectively. Additionally, the mechanical properties of the materials were evaluated using tensile testing, and the thermal properties were assessed through Differential Scanning Calorimetry (DSC). The antimicrobial activities of the scaffolds and their incubation media in PBS (pH 7.4, at 37°C for 24 hours) were tested using the agar disc diffusion method. This test was conducted on two Gram-positive and two Gram-negative standard pathogenic bacteria. To determine the cell viability of human fibroblast cells (CCD-1072Sk) incubated with free ST, ST loaded, and unloaded 3D printed scaffolds the colorimetric MTT assay was used. Annexin V- Propidium Iodide double stain assay

was performed to test whether early or late apoptosis was induced in the PLA/CS/1 % ST and PLA/CS/2 % ST loaded groups. Lastly, a wound healing assay was conducted to evaluate the effect of ST-loaded 3D-printed scaffolds on wound healing in CCD-1072Sk cells.

The results of MTT assay showed that the 1 % and 2 % (wt) ST loaded PLA/CS/ST 3D printed scaffolds caused an increase in the cell number. The apoptosis assay results were coherent with the MTT assay results. In the wound healing assay the highest wound closure compared to the control group was observed on cells treated with PLA/CS/1 % ST for 72 h. Overall the results received shows that ST loaded PLA/CS/ST 3D printed scaffolds showcase a great potential to be used in tissue engineering and wound healing applications.

Polymer Based Dental Membrane

Hilal Gulsena Nur Akkus [1*], Cem Bulent Ustundag[1,2], Azime Erarslan[1], Israa F. Abdulazez[1], Ayşe Betul Bingöl[1] , Buşra Oktay[1]

[1]Department of Bioengineering, Faculty of Chemical and Metallurgical Engineering, Yildiz Technical University, Istanbul, Turkey

[2] Health Biotechnology Center for Excellence Joint Practice and Research, (SABIOTEK), Yildiz Technical University, Istanbul, Turkey

*Correspondence: gulsenaakkus01@gmail.com

ABSTRACT

Dental membranes provide predictable bone grafting in dental surgery applications, filling of bone defects, and dental implant placement. Resorbable and non-resorbable membranes can be used according to the application. In this study, the membrane has a double-layer structure that allows filling of defects, supports bone healing and prevents bacterial growth taking into consideration the shortcomings of other treatment methods. FDA-approved, resorbable and biocompatible polymers were used when creating the scaffold structure. The dressing consists of a nanofiber structure and a double-layer structure produced by the electrospinning method. The first layer contains Poly-vinyl alcohol (PVA), hydroxyapatite and collagen, and the second layer contains Poly-caprolactone (PCL) and collagen. This will help adjust the degradation times of the layers and contribute to a controlled treatment. Hydroxylapatite is the mineral form of calcium apatite found in nature. The mineral, which can be produced both naturally and synthetically, is found in tooth enamel and dentin layer and bones. Today, it is a material that can be used instead of bone. Hydroxyapatite is the main component and essential mineral of both bone and teeth. The scaffold also prevents the risk of infection and in order to provide antibacterial properties, electrospray was applied on these layers with PVA and amoxicilin solution. With this method, which is a topical application, drugs will be used in low doses and side effects will be minimized. After the production process, the dental membrane structure was characterized by methods such as morphological (microscope), molecular interaction (FT-IR), and mechanical strength (tensile-strain test), microbial analysis. This study is intended to provide researchers with a basis for future research.

References

1. Reference 1: Membrane barriers for guided bone regeneration: An overview of available biomaterials, Mizraji G., Special Issue:BONE REGENERATION IN IMPLANT DENTISTRY Volume93, Issue1, 2023.
2. Reference 2 : The Use of Biocompatible Membranes in Oral Surgery: The Past, Present & Future Directions. A Narrative Review, Kormas I., *Membranes* 2022, *12*(9), 841, 2022.
3. Reference 3: Barrier membranes for tissue regeneration in dentistry, Sasaki J., Biomater Investig Dent.; 8(1): 54–63, 2021.

Slow Release Properties of Bioglass Impregnated with Essential Oils and Surfactants

Ioana LIXANDRU MATEI, Sava Bogdan ALEXANDRU

[1]Botanical SRL, 7 Trandafirilor, Tatarani, Prahova county, 107059, Romania.
[2] University Politehnica of Bucharest, 011061 Bucharest, Romania, Doctoral School of Applied Chemistry and Materials Science
*Correspondence: ioana@clinica-plush.ro

ABSTRACT

An important aspect of extending the dosing period in the epidermis and improving the efficiency of the active bioagents present in skin care creams refers to the use of nanoparticles with optimal granulometric distribution and pore size for the incorporation of these bioagents into the respective creams. Active materials based on natural compounds are mentioned in specialized literature as a viable alternative to maintain the effectiveness of cosmetic creams. Active agents such as essential oils, natural compounds with antioxidant, antimicrobial and antiviral activity, are typically incorporated into various 1-5 powdery solids. In this paper, the rate of release of some essential oils, impregnated at various concentrations on two bioactive glass powders by thermogravimetric analysis, was studied, in the perspective of use in the preparation of cosmetic creams.
Bioactive glass powders were characterized by the determination of textural characteristics (Fig. 1.), particle size distribution, FTIR spectrum and electron microscopy. The rate of essential oils was quantified based on the thermogravimetric curve and correlated with the textural characteristics of the bioactive glass powders. The essential oils used at this stage to evaluate the release rate from bioactive glass powders were cinnamon oil, coriander oil and clove oil. A correlation between the rate of essential oil elaboration and the characteristics of the bioactive glass powders was observed.

Criteria number	Product name, serial number	Specific surface area (m^2/g)	Total volume of pores (cm^3/g)	Average diameter of pores (nm)
1.	BG-1	1,518	0,0042	11,18
2.	BG-2	1,631	0,0047	11,27

Figure 1. Textural characteristics of bioactive glass powders

References

1. A.C. Guimaraes, et al., Antibacterial activity of terpenes and terpenoids present in essential oils, Molecules 24 (13) (2019).

2. Albert Mihranyan, Natalia Ferraz, Maria Strømme, Current status and future prospects of nanotechnology in cosmetics, Progress in Materials Science, Volume 57, Issue 5, June 2012, Pages 875-910.
3. Arthur Henrique Garcia Pinto, Rocio Geng-Vivanco, Fernanda de Carvalho Panzeri Pires-de-Souza, Effect of limonene associated with bioactive glass-ceramic on dentin/adhesive interface, European Journal of Oral Sciences, Volume131, Issue5-6, October/November 2023, https://doi.org/10.1111/eos.12947.
4. D.Y. Liang, B.J. Feng, N. Li, L.H. Su, Z. Wang, F.S. Kong, Y.G. Bi, Preparation, characterization, and biological activity of Cinnamomum cassia essential oil nanoemulsion, Ultrason. Sonochem. 86 (2022) 106009, https://doi.org/10.1016/J.ULTSONCH.2022.106009.
5. Fatemeh Khodadadi, Maryam Nikzad, Sepideh Hamedi, Lignin nanoparticles as a promising nanomaterial for encapsulation of Rose damascene essential oil: Physicochemical, structural, antimicrobial and in-vitro release properties, Colloids and Surfaces A: Physicochemical and Engineering Aspects, Volume 687, 20 April 2024, 133580.
6. Irshaan Syed, Sourav Garg, Preetam Sarkar, 5 - Entrapment of essential oils in hydrogels for biomedical applications, Polymeric Gels Characterization, Properties and Biomedical Applications Woodhead Publishing Series in Biomaterials 2018, Pages 125-141.
7. Katharina Schuhladen, Judith A. Roether, Aldo R. Boccaccini, Bioactive glasses meet phytotherapeutics: The potential of natural herbal medicines to extend the functionality of bioactive glasses, Biomaterials, Volume 217, October 2019, 119288.
8. N. Sharip, et al., Formulation Of Plant Based Cooling Agent From Peppermint Oil, Multidiscip. Appl. Res. Innov. 2 (2) (2021) 308–312-308–312.
9. Özarslan, A.C., Özel, C., Okumuş, M.D. et al. Development, structural and rheological characterization, and in vitro evaluation of the zinc-doped 45S5 bioactive glass-vaseline ointment for potential wound healing applications. Journal of Materials Research 38, 1557–1572 (2023).
10. Reza Monfared-Hajishirkiaee, Hamide Ehtesabi, Hamid Latifi, Peppermint essential oil and ZnO nanoparticles: A green and effective combination for a cooling bilayer patch with antibacterial activity, Journal of Environmental Chemical Engineering 12 (2024) 112833.
11. Simin Fan, Qingfeng Yang, Debao Wang, Chaoqiao Zhu, Xiangyuan Wen, Xin Li, Aurore Richel, Marie-Laure Fauconnier, Wei Yang, Chengli Hou, Dequan Zhang, Zein and tannic acid hybrid particles improving physical stability, controlled release properties, and antimicrobial activity of cinnamon essential oil loaded Pickering emulsions, Food Chemistry, Volume 446, 15 July 2024, 138512.
12. Siqi Zhao, Yuexin Li, Qian Liu, Xiufang Xia, Qian Chen, Haotian Liu, Baohua Kong, Characterization, release profile, and antibacterial properties of oregano essential oil nanoemulsions stabilized by soy protein isolate/tea saponin nanoparticles, Food Hydrocolloids, 151 (2024) 109856.
13. S. Pourshahrestani, et al., Polymeric hydrogel systems as emerging biomaterial platforms to enable hemostasis and wound healing, Adv. Healthc. Mater. 9 (20) (2020) 2000905.
14. Xu Fan, Jiamin Zhu, Ying'ao Zhu, Chengyun Duan, Pengyuan Sun, Qian Chen, Baohua Kong, Hui Wang, Oregano essential oil encapsulated in zein-pectin-chitosan nanoparticles to improve the storage quality of Harbin red sausage, International Journal of Biological Macromolecules, Volume 266, Part 2, May 2024, 131322.

Complex 3D Printed Architectures for Skin Tissue Repair and Regeneration

Isabella Nacu[1,2], Andrei Tunaru[1], Ioana Ilie[1], Loredana Elena Niţă[2], Liliana Vereştiuc[1]

[1]Faculty of Medical Bioengineering, Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania

[2]Petru Poni Institute of Macromolecular Chemistry, 41-A Grigore Ghica Voda Alley, 700487 Iasi, Romania

*Correspondence: cobzariu.isabella@gmail.com

ABSTRACT

Wound healing is an intricate and constantly evolving biological process that triggers the immune system to repair damaged tissue. Since the 1960s [1], various wound dressings have been designed for wound healing due to their ability to establish a suitable environment for skin regeneration [2]. Wound dressings cover the wound, promote epithelial tissue development, reduce physical damage, and prevent infections. Hydrogels, known for their exceptional biochemical and mechanical characteristics, have demonstrated benefits in the field of wound dressings. Significant progress has been made in regenerative medicine with the utilization of 3D printing technology and 3D printed matrices. These matrices are designed with specific structures and capabilities to improve the healing process of skin wounds [3]. (Bio)inks are essential constituents of 3D printing technologies and biocompatible polymers, whether natural or synthetic, were tested and some commercial products were developed. These polymers undergo crosslinking reactions between macromolecules resulting in a mechanically robust structure.

This paper presents the preparation of hybrid polymeric (bio)inks based on different types of methacrylated polymers (gelatin – GelMA, sodium alginate - AlgMA, xanthan gum - XMA) and hyaluronic acid (HA) to obtain 3D printed scaffolds. The scaffolds were characterized and compared for their properties to establish the optimal ink composition and applicability in soft tissue engineering.

The biopolymers were modified using the approach outlined by Camci-Unal [4], by slightly modifying the procedure. Further, to prepare inks, GelMAs, XMA, AlgMA and HA were combined, varying the type of gelatin used, along with a photoinitiator and cell suspension (for bioinks). The mixtures were homogenized, printed using an Inkredible$^+$ Cellink bioprinter, and subjected characterization methods, and afterwards subjected to freeze-drying for further characterization (-54^{o}C; 0.07 mBar). The resulted scaffolds were assessed for their structure and morphology, capacity to expand under simulated physiological properties, degradability, mechanical characteristics, bioadhesion, wound healing and *in vitro* cytocompatibility. The composition of the scaffolds influences pore sizes, degradation rates, bioadhesivness and swelling ratio and scaffolds based on bovine-origin gelatin presented increased bioadhesive characteristics. The 3D printed scaffolds are non-cytotoxic and capable to support the further development of cells, being suitable for soft tissue engineering. Also, the bioprinted scaffolds have pores that favor the diffusion of nutrients to support cells attachment, their development and proliferation. Besides

compatibility, scaffolds demonstrated wound healing effect, an all these properties recommend these materials for future investigation as matrices for soft tissue engineering.

Acknowledgments: This research was funded by a grant of the Ministry of Research, Innovation and Digitization, CCCDI - UEFISCDI, project number 613 PED/2022, PN-III-P2–2.1-PED-2021-3003, within PNCDI III.

References

1.Ribeiro M., et all. Gels 10.3 (2024): 188.

2.Yang C., Ding X., et all, Chemical Engineering Journal 456, 2023: 140886;

3.Diller R.B., et all. Biomimetics 7.3 (2022): 87.

4.Camci-Unal G., Cuttica D., et all., Biomacromolecules, 2013, 14(4), 1085-92;

Assessing the Effect of pH and Immersion Time on ZnO-Based Thin Films Synthesized via Automated SILAR Process for Gas Sensor Applications

Ismail Haijoub[1], Brahim Ydir [1], Mouad Soumane [1,2], Nejma Fazouan [2], El Houssine Atmani [2], Houda Lahlou [1], Radouane Leghrib [1]

[1] Laboratory of Materials, Signal, Systems and Physical Modeling, Physics Department, University of Ibnou Zohr, Agadir, Morocco

[2] Laboratory of Nanostructures and Advanced Materials, Mechanics and Thermofluids, Physics Department, Faculty of Sciences and Technologies, Hassan II University of Casablanca, Mohammedia, Morocco.

*Correspondence: ismail.haijoub.25@edu.uiz.ac.ma

ABSTRACT

In recent years, gas sensors based on semiconducting materials have increasingly gained tremendous interest from researchers due to their captivating properties and their immense performances in various fields related to industry, environment, biomedicine and agrofood, etc [1]. More particularly, ZnO is listed as a semiconducting metal oxide with a bandgap of approximately 3.37 eV, which gives promising prospects in the field of gas sensors [2].

In this work, ZnO thin films were synthesized via an automated Successive Ionic Layer Adsorption and Reaction (SILAR) technique [3]. In this study, the effect of pH and immersion time were studied at the same time. For that, film deposition trials were carried out at variable solution pH values, ranging from 10 to 11.75 and variable immersion times of 2.5; 5; 7.5 and 10 s. Afterwards, the synthesized samples were characterized by XRD, SEM and UV-Vis spectroscopy.

We noticed that the change of pH affected both solution quality and film surface properties. Interestingly, it resulted in a clear transformation of film morphology from ZnO nanograin morphology typically obtained by using SILAR process to other interesting 1D and 2D morphologies. Concerning the effect of the immersion time, we observed that by varying the immersion time from 2.5 towards 10 s, the film crystallinity, average crystallite size, thickness and optical transmittance.

References

1. K. G. S, M. Kaur, M. Shaheera, A. Pathak, S. C. Gadkari, and K. Debnath, “Sensors and Actuators : B . Chemical Highly sensitive NO 2 sensor based on ZnO nanostructured thin film prepared by SILAR technique,” Sensors Actuators B. Chem., vol. 335, no. 2, p. 129678, 2021, doi: 10.1016/j.snb.2021.129678.

2. G. Yergaliuly, B. Soltabayev, S. Kalybekkyzy, Z. Bakenov, and A. Mentbayeva, “Effect of thickness and reaction media on properties of ZnO thin films by SILAR,” Sci. Rep., vol. 12, no. 1, pp. 1–13, 2022, doi: 10.1038/s41598-022-04782-2.

3. B. Ydir, D. Ben Hmamou, Y. Ait-Wahmane, A. Ihlal, M. Bousseta, and H. Lahlou, “Design, implementation, and characterization of an automated SILAR system: validation with ZnO thin film deposition,” *Int. J. Adv. Manuf. Technol.*, vol. 123, no. 3–4, pp. 1189–1201, 2022, doi: 10.1007/s00170-022-10207-1.

Biocompatible and Conductive Cardiac Patches: Electrospun PCL-Reduced Graphene Oxide-Collagen-Gelatin Composites for Tissue Regeneration

Israa F. Abdulazez[1,2], Buşra Oktay[2], Ayşe Betül Bingöl[2], Prof. Dr. Cem Bülent Üstündağ[2,3]

[1]University of Baghdad, Al-Khwarizmi College of Engineering, Biomedical Engineering Department, Baghdad, Iraq

[2]Department of Bioengineering, Faculty of Chemical and Metallurgical Engineering, Yildiz Technical University, Istanbul, Turkey

[3]Health Biotechnology Center for Excellence Joint Practice and Research, (SABIOTEK), Yildiz Technical University, Istanbul, Turkey

*Correspondence: phd_bme@kecbu.uobaghdad.edu.iq

ABSTRACT

Myocardial infarction (MI) is a common life-threatening cardiovascular disease caused by blockage in one or more coronary arteries, resulting in damage to the myocardium. Scientists have actively sought innovative approaches to delay the progression of myocardial damage and facilitate the repair of affected tissue. Among these strategies, cardiac patches, scaffold-like structures placed on the surface of the heart, have emerged as a promising solution.

These patches provide significant mechanical support to the infarcted area and improve cardiac function by facilitating myocardial repair and regeneration. This approach has shown significant therapeutic potential in the treatment of MI.

Different kinds of biomaterials have been used; Polycaprolactone (PCL), reduced graphene oxide (rGO), collagen, and gelatin alone or together with an electrospinning technique to demonstrate the biological performance of the electrospun cardiac patch on infarcted heart tissue.

Electrospinning, a multipurpose technique for fabricating nanofibrous scaffolds, has developed as a source method for creating these patches. This technique allows to production of fibrous structures that closely mimic the extracellular matrix of native cardiac tissue, providing an optimal environment for cell attachment, proliferation, and differentiation. PCL is used for its biocompatibility, biodegradability, and high mechanical properties. rGO is used to increase the electrical conductivity of the patch as it is in the heart muscle. Collagen and gelatin are used to raise the biocompatibility and the hydrophilicity of the electrospun fiber.

Here, we present the fabrication and application of electrospun cardiac patches that are made to improve myocardial repair. The electrospinning process enables the integration of biocompatible and biodegradable polycaprolactone (PCL) polymer, which degrades over time and is replaced by native tissue. Additionally, electrospinning allows for the incorporation of bioactive molecules, including growth factors and extracellular matrix proteins, to further promote tissue regeneration.

Mechanical and chemical characterization of the electrospun patches reveals that they possess the necessary tensile strength and elasticity to support cardiac tissue regeneration. As a result, biomaterials with specific biocompatibility and mechanical properties have attracted great attention for their applications in heart patch development.

In conclusion, electrospun cardiac patches represent a significant advancement in cardiac regenerative medicine. By providing a scaffold that supports cell growth and tissue regeneration, these patches hold great promise for improving outcomes in patients with myocardial damage. Further research and clinical trials are necessary to fully realize their potential and translate these findings into clinical practice.

References

9. Chang, T., et al. (2021). "Biomaterials based cardiac patches for the treatment of myocardial infarction." Journal of Materials Science & Technology **94**: 77-89.

6. Elde, S., et al. (2021). "The expanding armamentarium of innovative bioengineered strategies to augment cardiovascular repair and regeneration." Frontiers in Bioengineering and Biotechnology **9**: 674172.

7. Ghosal, K., et al. (2021). "Graphene family nanomaterials-opportunities and challenges in tissue engineering applications." FlatChem 30: 100315.

8. Gohari, P. H. M., et al. (2021). "The effect of adding reduced graphene oxide to electrospun polycaprolactone scaffolds on MG-63 cells activity." Materials Today Communications 27: 102287.

9. Ma, W., et al. (2022). "Electrospun PCL/collagen hybrid nanofibrous tubular graft based on post-network bond processing for vascular substitute." Biomaterials Advances 139: 213031.

10. Perez-Puyana, V., et al. (2021). "Fabrication of hybrid scaffolds obtained from combinations of PCL with gelatin or collagen via electrospinning for skeletal muscle tissue engineering." Journal of Biomedical Materials Research Part A 109(9): 1600-1612.

11. Wang, L., et al. (2021). "Injectable and conductive cardiac patches repair infarcted myocardium in rats and minipigs." Nature Biomedical Engineering 5(10): 1157-1173.

Some Aspects in the Evaluation of Biomaterials Based on Collagen from the Umbilico-Placentary Complex

Jian Mariana[1], Mostovei Andrei[8], Solomon Oleg[6], Motelica Ludmila[5], Oprea Ovidiu Cristian[5], Cobzac Vitalie[4], Nacu Ana – Maria[4], Ficai Anton [1-3,5,7], Nacu Viorel[4]

[1] Science and Engineering of Oxide Materials and Nanomaterials, Faculty of Applied Chemistry and Materials Science, University POLITEHNICA of Bucharest, Gh. Polizu 1-7, 011061 Bucharest, Romania;

[2] National Research Center for Food Safety, University POLITEHNICA of Bucharest, Splaiul Independentei 313, 060042 Bucharest, Romania;

[3] National Center for Micro and Nanomaterials, University POLITEHNICA of Bucharest, Splaiul Independentei 313, 060042 Bucharest, Romania;

[4] Laboratory of Tissue Engineering and Cell Cultures, Nicolae Testemitanu State University of Medicine and Pharmacy, Stefan cel Mare street 165, Chisinau, Moldova

[5] Department of Inorganic Chemistry, Physical Chemistry and Electrochemistry, Faculty of Applied Chemistry and Materials Science, University POLITEHNICA of Bucharest, Gh. Polizu 1-7, 011061 Bucharest, Romania.

[6] Ilarion Postolachi Department of Orthopaedic Stomatology

[7] Academy of Romanian Scientists, Ilfov Street 3, 050044 Bucharest, Romania;

[8] Arsenie Guțan Department of Oral-Maxillofacial Surgery and Oral Implantology

*Correspondence: mariana.jian@usmf.md

ABSTRACT

Collagen is a fibrillar protein found in soft and hard tissues, being the main component of the extracellular matrix and contributes to maintain its integrity. Collagen is used in medical applications due to biocompatibility, biodegradability and non-immunogenicity. The purpose of this study is to evaluate the physical properties of biomaterials based on collagen extracted from the human umbilico-placental complex. In the experimental groups, before collagen extraction the ombelico-placental complexes were minced and washed with different surfactants to remove all blood content and non collagenous proteins, with the following concentrations 1% EDTA, 0.1% SDS, 1% SDC. The collagen extracted from the unpurified ombelico-placental complex served as control. After freeze-drying of 1% collagen suspension from each group, were performed FTIR analysis and elasticity modulus determination. A Nicolet iN 10 MX FTIR microscope (Thermo Fisher Scientific, Waltham, MA, USA) was used to record the maps with the spatial distribution of the components. All measurements were performed at room temperature using the attenuated total reflection (ATR) fixture, with the detector cooled by liquid nitrogen. Each spectrum is recorded between 600 and 4000 cm-1 with a resolution of 4 cm-1. In order to determine the physical properties of the obtained collagen samples, 7 cylindrical pieces of each sample were sectioned with a biopsy punch of 4.5 mm in diameter. After saturation overnight with 0.01M PBS pH 7.4 at RT, the elasticity modulus (E) was determined after height and diameter appreciation of the hydrated samples. The measurements were made using the TA.XT plus texture analyzer by applying a trigger force of 2.0 g and a compression of 0.1% of the height of the samples. The elasticity modulus of the control samples was E =

0.04 ±0.02 Mpa. There was found no significant difference between the control collagen samples and those extracted after using SDS, E = 0.07 ±0.04 Mpa ($p > 0.1$), but significant difference was found when comparing the collagen samples extracted using SDS and EDTA with the control group, E = 0.24 ±0.13 Mpa ($p < 0.005$) and respectively E = 0.06 ±0.01 Mpa ($p < 0.05$).

References:

1. Dong C, Lv Y. Application of Collagen Scaffold in Tissue Engineering: Recent Advances and New Perspectives. Polymers (Basel). 2016;8(2):42. Published 2016 Feb 4. doi:10.3390/polym8020042.
2. Amirrah IN, Lokanathan Y, Zulkiflee I, Wee MFMR, Motta A, Fauzi MB. A Comprehensive Review on Collagen Type I Development of Biomaterials for Tissue Engineering: From Biosynthesis to Bioscaffold. Biomedicines. 2022;10(9):2307. Published 2022 Sep 16. doi:10.3390/biomedicines10092307.

Acknowledgements:

The study was carried out within the project number 23.70105.8007.01T: "Obtaining and testing the composite biomaterials based on collagen from the umbilical-placental complex and hydroxyapatite for oral-maxillo-facial surgery".

Potential Application of PVA based Electrospun Nanofiber Mates

Karanjit Kapila[1,*], Sushen Kirtania[1]

[1] Department of Mechanical Engineering, Tezpur University, Tezpur, India.

*Correspondence: kkapilaresearch@gmail.com

ABSTRACT

Electrospinning is a well-established technique for generating nano and micro fibers. Graphene oxide (GO) have garnered considerable scientific interest due to their outstanding characteristics, such as superior electron transport, excellent mechanical properties, high surface area, and antibacterial capabilities. Poly(vinyl alcohol) (PVA) solutions incorporated with GO were prepared for electrospinning, and the spinnability of these solutions was analyzed in relation to their properties. This research focused on electrospinning PVA solutions mixed with GO onto a rotating collector, aiming to merge the distinct physical properties of these materials. The study also examined how varying solutions and rotation speeds affected the fiber morphology. The process optimization highlighted the significant roles of the flow rate and the distance between the tip and collector in conjunction with the rotation speed [1,2].

Keywords: polyvinyl alcohol; graphene oxide; electrospinning; mechanical properties; water vapor permeability

References

1 Kapila, K., Kirtania, S., Development of PVA-based electro-spin nanofiber mats and its characterization Development of PVA-based electro-spin nanofiber mats and its characterization. Applications of Chemistry in Nanosciences and Biomaterials Engineering (NanoBioMat) 2023 – Winter Edition Conference. ISSN 3008-6124 ISSN-L 3008-6124

2 Kapila, K., Kirtania, S., Devi, L.M., Saikumar, A., Badwaik, L.S. and Rather, M.A., 2024. Potential perspectives on the use of poly (vinyl alcohol)/graphene oxide nanocomposite films and its characterization. Journal of Food Measurement and Characterization, 18(2), pp.1012-1025.

Curcumin and Lidocaine Hydrochloride USP Monohydrate Loaded Wound Dressing for the Treatment of Moderate Burns

Kardelen Gürbüz[1], İlknur Danış[1], Melike Atasoy[1], Ayşe Betül Bingöl[1], Büşra Oktay[1], Cem Bülent Üstündağ[1]

[1]Department of Bioengineering, Faculty of Chemical and Metallurgical Engineering, Yildiz Technical University, 34220, İstanbul, Turkey

*Correspondence: kardelen.grbz044@gmail.com

ABSTRACT

Various types of injuries occur in people under the influence of many different environmental or biological factors. Diabetic wounds, burn wounds, chemical burns and injuries resulting from surgical procedures are some of the types of wounds. Wound dressings made of nanofibers that provide rapid and effective healing are needed in the treatment of these wounds.In addition, it is of great importance that the wound dressing materials produced are designed according to the needs of the wound area to be applied.

This project aims to develop the production of a double-layered and multifunctional wound dressing for the treatment of second-degree burns. In order to make the pain relieving properties of the layer in direct contact with the wound more effective, the first layer is loaded with Lidocaine Hydrochloride USP Monohydrate pain reliever. Lidocaine Hydrochloride USP Monohydrate works by stopping sodium conduction through ion channels in nerve cells. In addition, PVA polymer is used in this layer so that the first layer can effectively absorb the exudate fluid formed in the wound. Turmeric extract (Curcumin) along with Polycaprolactone (PCL) is used in the second layer of the wound dressing. PCL, which is used as the main polymer in the production of many wound dressings, was preferred because it is biocompatible and can be turned into fiber. Curcumin found its place in this study because it is antimicrobial, antiviral, wound healing and is a cheap and plant-derived substance that can be found in abundance in nature.

Nanofiber layers were prepared as double layers using an electrospinning device. Layers were cross-linked to increase mechanical strength. Then, fiber formation was observed using an optical microscope. Fourier Transform Infrared Spectroscopy (FTIR) analysis was performed to examine the functional groups within the nanofibers. Tensile testing was applied to examine the mechanical strength of nanofibers. The optimization stages will be reviewed according to the results of the tensile test. The characterization of the nanofibers will be carried out with Scanning Electron Microscopy (SEM), X-Ray Diffractometer (XRD). Also, antimicrobial tests, drug release tests, swelling and degradation tests will be done.

Acknowledgment: This study is supported by the Turkish Health Institutes (TÜSEB) grant and project code is 32624.

References

1. Arafat, M. T., Mahmud, M. M., Wong, S. Y., & Li, X. (2021). PVA/PAA based electrospun nanofibers with pH-responsive color change using bromothymol blue and on-demand ciprofloxacin release properties. Journal of Drug Delivery Science and Technology, 61, 102297.
2. Fathollahipour, S., Abouei Mehrizi, A., Ghaee, A., Koosha, M. (2015). Electrospinning of PVA/chitosan nanocomposite nanofibers containing gelatin nanoparticles as a dual drug delivery system. Journal of Biomedical Materials Research Part A. 103(12). 3852-3862.
3. Saeed, S. M., Mirzadeh, H., Zandi, M., Barzin, J. (2017). Designing and fabrication of curcumin loaded PCL/PVA multi-layer nanofibrous electrospun structures as active wound dressing. Progress in biomaterials. 6(1). 39-48.

Exploring *Lantana Camara* Essential Oil as a green Corrosion Inhibitor for Carbon Steel in Acidic Environments

Khaoula Mzioud[1*], Souad El Fartah[1], Amar Habsaoui [1], Sara Rached [1], Kharbouch Otmane[1], Ebn touhami Mohamed[1]

[1] Laboratory Advanced Materials and Process Engineering, Faculty of Sciences, Ibn Tofaïl University, PB 133, Kenitra, 14000, Morocco. *Correspondence: khaoula.mzioud@uit.ac.ma

ABSTRACT

The widespread use of carbon steel across various industries owes to its affordability and excellent weldability. However, its susceptibility to corrosion in harsh environments poses significant challenges during service, leading to considerable economic losses. Industries employing acids for processes like industrial cleaning exacerbate metal damage, necessitating effective corrosion prevention strategies. Among the methods explored, corrosion inhibition emerges as a cost-effective and straightforward approach. While numerous inhibitors have been investigated, many prove toxic to both humans and the environment, underscoring the growing importance of environmentally friendly alternatives. In response to this demand, green corrosion inhibitors have garnered attention. Derived from natural sources, these inhibitors offer non-toxic, eco-friendly solutions. *Lantana camara L.*, a widely recognized aromatic shrub, presents itself as a promising candidate due to its rich chemical composition and reported medicinal properties. Despite its widespread use and chemical diversity, the inhibitory potential of Lantana camara essential oil on carbon steel corrosion in acidic environments remains unexplored, highlighting the novelty of this study. Through electrochemical techniques such as potentiodynamic study, electrochemical impedance spectroscopy (EIS), and surface analysis using SEM/EDX, the inhibitory efficacy of Lantana camara essential oil against carbon steel corrosion in 1 M HCl medium was evaluated. The study yielded impressive results in terms of corrosion resistance, registering at 90.3%. Furthermore, it highlighted that the inhibitor examined possessed a mixed nature, predominantly displaying cathodic characteristics.

References

1. K. Mzioud, A. Habsaoui, M. Ouakki, M. Galai, S. El Fartah, M. Ebn Touhami, (2020), Inhibition of copper corrosion by the essential oil of *Allium sativum* in 0.5M H_2SO_4 solutions. SN Applied Sciences, 2(9), 1611.
2. K. Mzioud, A. Habsaoui, S. Rached, R. Lachheb, N. Dkhireche, M. Ouakki, M. Galai, S. El Fartah, M. Ebn Touhami, (2022), Synergistic formulation from *Allium Sativum* essential oil and diethyl thiourea for corrosion inhibition of carbon steel in 0.5 M H_2SO_4 medium. Proceedings of the Sixth International Symposium on Dielectric Materials and Applications (ISyDMA'6). Springer, Cham. 251-266p.
3. S. Rached, K. Mzioud, A. Habsaoui, M. Galai, K. Dahmani, M. Ouakki, S. El Fartah, N. Dkhireche, M. Ebn Touhami, (2024), Inhibition of Copper Corrosion in Sulfuric Acid by Mentha Pulegium L., Port. Electrochimica Acta. 42 (2), pp. 137-153.

The Integration of PVA Hydrogel with Magnesium Phosphate – Development of Biocement for Advanced Medical Applications

Magdalena Górecka[1]*, Anna Ronowska[2], Aleksandra Mielewczyk-Gryń[3], Dawid Kozień[4] Justyna Kozłowska[5], Marcin Wekwejt[6]

[1]Scientific Club 'Materials in Medicine', Advanced Materials Center, Gdańsk University of Technology, 11/12 Gabriela Narutowicza Street, 80-233 Gdańsk, Poland

[2]Department of Laboratory Medicine, Faculty of Medicine, Medical University of Gdańsk, 3a Marii Skłodowskiej-Curie Street, 80-210 Gdańsk, Poland

[3]Department of Ceramics, Gdańsk University of Technology, 11/12 G. Narutowicza Street, 80-233 Gdańsk, Poland

[4]Department of Ceramics and Refractories, Faculty of Materials Science and Ceramics, AGH University of Krakow, 30-059 Krakow, Poland

[5]Department of Biomaterials Technology and Cosmetic Chemistry, Nicolaus Copernicus University in Toruń,
11 Gagarina Street, 87-100 Toruń, Poland.

[6]Department of Biomaterials Technology, Faculty of Mechanical Engineering and Ship Technology, Gdańsk University of Technology, 11/12 Gabriela Narutowicza Street, 80-233 Gdańsk, Poland

*Correspondence: s195693@student.pg.edu.pl

ABSTRACT

Cements are crucial bone substitutes in orthopedic and trauma surgeries, particularly for reconstruction, implant fixation, and fracture stabilization [1]. Magnesium phosphate cements (MPC) offer beneficial bioresorption, rapid setting time, and high mechanical strength, making them promising alternatives to traditional calcium phosphate cements. Despite these advantages, issues such as brittleness and limited injectability still pose significant challenges [2]. This research focuses on the integration of poly(vinyl alcohol) (PVA) hydrogel into MPC to enhance its properties for medical applications.

The biocomposite cement was developed by combining a powder phase of MgO and KH_2PO_4 with a liquid phase containing PVA polymer and varying concentrations of a cross-linking agent. This mixture forms a dual-self-setting and injectable paste. The analysis includes measuring setting time and temperature, inspecting microstructure, determining phase and chemical composition, evaluating static compressive strength, qualitatively assessing injectability, and conducting a cytocompatibility test with human osteoblasts.

Through this investigation, we have developed a novel dual-setting cement and our results demonstrate that this biocomposite is characterized by high cytocompatibility, enhanced mechanical properties, a satisfactory biodegradation rate, improved injectability, and effective setting at lower

temperatures. The enhanced compressive strength was attributed to the uniform dispersion of PVA within the matrix. The incorporation of cross-linked hydrogel significantly improved the paste's cohesion and resistance to washout, as well as increased its injectability potential. Ultimately, it shows significant potential for advanced medical applications, particularly in the fields of surgical orthopedics and traumatology.

Acknowledgment: This research was supported by the Gdańsk University of Technology by the DEC-3/2022/IDUB /III.4.3/Pu grant under the PLUTONIUM 'Excellence Initiative – Research University program.

References

1. B. Fang, Z.Hu, T. Shi i in. Ceram. Int. 2023, 3, 4001-4016
2. R. Gelli, G. Bernardini, F. Ridi. Ceram. Int. 2023, 19, 31466-31476

TiO_2/Fe_2O_3 Heterostructures for Photocatalytic Degradation of Reactive Yellow 176

Maria Grapin [1,2,*], Valentin Raditoiu[1,*], Alina Raditoiu[1] and Florentina Monica Raduly[1]

[1]National Institute for Research & Development in Chemistry and Petrochemistry–ICECHIM, 202 Spl. Independentei, 060021 Bucharest, Romania

[2] National University of Science and Technology Politehnica Bucharest, 313 Spl. Independentei, 060042 Bucharest, Romania

*Correspondence: maria.grapin@icechim.ro, vraditoiu@icechim.ro

ABSTRACT

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

Fabrication and Characterization of Hydroxyapatite/Polymethylmethacrylate based Nanocomposite for Biomedical Application

Mariam Sohail Mansoor[1**], Aneela Anwar[1*], Nayab Raza[1], Furqana Bibi[1]

[1]Department of Chemistry
University of Engineering and Technology, Lahore, Pakistan
**Correspondence: mariamjutt485@gmail.com
*Correspondence: a.anwar@uet.edu.pk

ABSTRACT

Poly(methyl methacrylate) (PMMA) is extensively utilized in orthopedic settings, such as bone cement for total joint replacement surgeries, bone fillers, and bone substitutes, owing to its cost-effectiveness, biocompatibility, and ease of processing. Nevertheless, PMMA's effectiveness in bone regeneration is hindered by its lack of bioactivity, poor osseointegration, and non-degradability. Bone tissue engineering has attracted interest in the biomedical community recently. The main goal of bone tissue engineering is to structurally and functionally duplicate the extracellular matrix ECM of bone to produce fibers with excellent biocompatibility, osteoinductivity, and mechanical properties. Orthopedic bone tissue engineering is especially interested in the creation of novel products that contain efficiently antibacterial polymethylmethacrylate nanofibers around well-organized nanocrystalline hydroxyapatite nanoparticles. In the current investigation, two steps were used to create hydroxyapatite-doped, ultra-thin PPMA fibers. Hydroxyapatite nanocrystals were initially created via a wet chemical process. The electrospinning process was utilized to create composite fibers utilizing the nanocrystals that had just been synthesized. Additionally, using bone cement poses issues like the release of methyl methacrylate (MMA) and high exothermic temperatures during PMMA polymerization, potentially leading to thermal necrosis. To mitigate these challenges, various approaches have been explored, including surface modification techniques and the incorporation of bioactive agents and biopolymers into PMMA. The physicochemical properties and synthesis methods of PMMA, emphasize the use of PMMA composites in bone tissue engineering. It also discusses the challenges of integrating PMMA into regenerative medicine, supported by relevant research findings, aiming to offer valuable insights for its successful clinical application.

References

1. Ramanathan, S., Lin, Y. C., Thirumurugan, S., Hu, C. C., Duann, Y. F., & Chung, R. J. (2024). Poly (methyl methacrylate) in Orthopedics: Strategies, Challenges, and Prospects in Bone Tissue Engineering. Polymers, 16(3), 367
2. Kattimani, V. S., Kondaka, S., & Lingamaneni, K. P. (2016). Hydroxyapatite–-Past, present, and future in bone regeneration. Bone and Tissue Regeneration Insights, 7, BTRI-S36138

Gellan Hydrogel Enhancement in Magnesium Phosphate Cement for Advanced Medical Applications

Maryia Khamenka[1]*, Anna Ronowska[2], Aleksandra Mielewczyk-Gryń[3], Dawid Kozień[4] Justyna Kozłowska[5], Marcin Wekwejt[6]

[1]Scientific Club 'Materials in Medicine', Advanced Materials Center, Gdańsk University of Technology, 11/12 Gabriela Narutowicza Street, 80-233 Gdańsk, Poland

[2]Department of Laboratory Medicine, Faculty of Medicine, Medical University of Gdańsk, 3a Marii Skłodowskiej-Curie Street, 80-210 Gdańsk, Poland

[3]Department of Ceramics, Gdańsk University of Technology, 11/12 G. Narutowicza Street, 80-233 Gdańsk, Poland

[4]Department of Ceramics and Refractories, Faculty of Materials Science and Ceramics, AGH University of Krakow, 30-059 Krakow, Poland

[5]Department of Biomaterials Technology and Cosmetic Chemistry, Nicolaus Copernicus University in Toruń,
11 Gagarina Street, 87-100 Toruń, Poland.

[6]Department of Biomaterials Technology, Faculty of Mechanical Engineering and Ship Technology, Gdańsk University of Technology, 11/12 Gabriela Narutowicza Street, 80-233 Gdańsk, Poland

*Correspondence: s187728@student.pg.edu.pl

ABSTRACT

Bone cements are indispensable in orthopedic and trauma surgeries, serving crucial roles such as bone reconstruction, implant fixation, and fracture stabilization [1]. Recent studies indicate that magnesium phosphate cements (MPC) are a good alternative to traditional phosphate-calcium cements due to rapid setting time, significant mechanical strength, and optimal biodegradability. However, challenges such as brittleness and injectability remain [2]. This research focuses on the integration of gellan gum (GG) hydrogel into MPC to overcome these limitations and enhance the material's properties, particularly for minimally invasive surgical applications.

The cement formulation investigated in this study combines a powder phase consisting of MgO, KH_2PO_4, and a retarding agent with a liquid phase composed of GG solution with a plasticizer, forming an injectable and self-hardening paste. Key properties of the proposed biocomposite cement were comprehensively evaluated, like: setting time and temperature, microstructure, mechanical strength, biodegradation rate, phase and chemical composition, injectability, and cytocompatibility.

The MPC+GG cement demonstrated effective hydration reaction at lower temperature, reduced brittleness and significantly improved injectability - enhancing its suitability for minimally invasive procedures. Further, the material also showed good compatibility with osteoblasts, suitable porosity, and an adequate biodegradation rate. These findings indicate the substantial applicability of this innovative biocomposite cement in medical engineering, presenting a promising avenue for future research and clinical applications in bone surgery.

Acknowledgment: This research was supported by the Gdańsk University of Technology by the DEC-3/2022/IDUB /III.4.3/Pu grant under the PLUTONIUM 'Excellence Initiative – Research University program.

References

1. G. Fernandez de Grado, L. Keller, Y. Idoux-Gillet, et all, J. Tissue Eng. 2018, 9.
2. L. Xuan, C. Bing. Construction and Building Materials, 2016. 123.

Temperature-responsive N-isopropylacrylamide (NIPAm) and gelatin methacryloyl (GelMA)-based hydrogels for controlled drug delivery

Maria Daaboul[1], Ayse Akkaya[2], Oguzhan Gunduz[3,4], Emine Alarcin[2], Mehmet Murat Ozmen[1]*, Murat Topuzogullari[1]*

[1]Department of Bioengineering, Faculty of Chemistry and Metallurgy, Yildiz Technical University, Istanbul, Turkey

[2]Department of Pharmaceutical Technology, Faculty of Pharmacy, Marmara University, Istanbul, Turkey

[3]Center for Nanotechnology & Biomaterials Application and Research (NBUAM), Marmara University, Istanbul, Turkey

[4]Department of Metallurgical and Materials Engineering, Faculty of Technology, Marmara University, Istanbul, Turkey

***Correspondence:** mtopuzoullar@gmail.com, ozmenmurat@yahoo.com

ABSTRACT

Smart polymers, including hydrogels, are a promising class of materials with a wide range of applications in biomedical science. Particularly hydrogels have a unique ability to swell or shrink in response to external stimuli such as temperature fluctuations. Temperature-responsive hydrogels, a subtype of smart polymers, exhibit reversible phase transitions in response to temperature changes, which gives suitable control over their behaviour. This reversible response offers dynamic volume alteration of the hydrogel, making them ideal candidates for use in drug delivery systems, tissue engineering, and biosensors. Their variable temperature sensitivity provides benefits such as targeted drug release at specific body regions, improved cell encapsulation and proliferation, and sensitive detection of biological substances. Overall, smart polymers, particularly temperature-responsive hydrogels, offer customized solutions for challenging issues, opening up novel opportunities for biomedicine, materials science, and other fields.Temperature-responsive N-isopropylacrylamide (NIPAm) hydrogels undergo a reversible phase transition near body temperature, swelling at lower temperatures and collapsing at higher temperatures, allowing drug release control triggered by temperature changes. This feature enables precise control over drug release stimulated by slight changes in temperature. On the other hand, gelatin methacryloyl (GelMA) hydrogels, represent a versatile class of biomaterials derived from gelatin, offer excellent biocompatibility, tuneable mechanical properties, and the ability to encapsulate various drugs. Both GelMA and NIPAm hydrogels hold promise in controlled drug delivery and combining their unique properties could lead to the development of advanced drug delivery systems suitable for specific therapeutic needs, improving controlled drug release.In this study, temperature-responsive hydrogels composed of NIPAm, GelMA and polyethylene glycol diacrylate (PEGDA) were synthesized utilizing the photo-initiator lithium phenyl (2,4,6-trimethylbenzoyl) phosphinate (LAP). Polylactic-co-glycolic acid (PLGA) nanoparticles loaded with the antiepileptic drug phenytoin, serving as a model system, were embedded into these hydrogels to investigate their drug release behaviour. The produced bare and PLGA nanoparticle-integrated hydrogels were characterized with Fourier

transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), X-ray diffraction analysis (XRD) and scanning electron microscopy (SEM) in addition to the swelling and drug release tests. The results showed the reversible response of the synthesized hydrogels to temperature fluctuation between both (25 ℃ - 37 ℃) and (37℃ - 40℃), suggesting their potential in various applications including temperature-sensitive controlled drug delivery systems, encouraging further research and development in biomedical and pharmaceutical fields.

Keywords: Controlled drug delivery, Gelatin methacryloyl (GelMA), Hydrogels, N-isopropylacrylamide (NIPAm), Smart polymers.

Acknowledgments: This study was supported financially by TUBITAK with the 23AG008 project number.

References

[1] M. Neumann *et al.*, 'Stimuli-Responsive Hydrogels: The Dynamic Smart Biomaterials of Tomorrow', *Macromolecules*, vol. 56, no. 21, pp. 8377–8392, Nov. 2023, doi: 10.1021/acs.macromol.3c00967.

[2] S. M. H. Dabiri *et al.*, 'Multifunctional Thermoresponsive Microcarriers for High-Throughput Cell Culture and Enzyme-Free Cell Harvesting', *Small*, vol. 17, no. 44, p. 2103192, 2021, doi: 10.1002/smll.202103192.

[3] N. A. Shaibie, N. A. Ramli, N. D. F. Mohammad Faizal, T. Srichana, and M. C. I. Mohd Amin, 'Poly(N-isopropylacrylamide)-Based Polymers: Recent Overview for the Development of Temperature-Responsive Drug Delivery and Biomedical Applications', *Macromol. Chem. Phys.*, vol. 224, no. 20, p. 2300157, 2023, doi: 10.1002/macp.202300157.

[4] L. Xiang and W. Cui, 'Biomedical application of photo-crosslinked gelatin hydrogels', *J. Leather Sci. Eng.*, vol. 3, no. 1, p. 3, Feb. 2021, doi: 10.1186/s42825-020-00043-y.

Synthesis and Development of Perovskite Materials for Advance Energy Generation

Muhammad Salman Habib[1], Muhammad Asif Rafiq

[1]Department of Metallurgical and Materials Engineering
University of Engineering and Technology Lahore, Pakistan
*Correspondence: salmanahabib2000@gmail.com

ABSTRACT

Energy take over the human develelopment and welfare. The continous demand of energy generation varies logarithimally with the depeleting non-renewable energy resources. The challenge accepted by perovskite materials to generate, store and utilize energy without emissions. These can be prepared by solid-state synthesis, sol-gel, and hydrothermal. This synthesis of perovskite materials make them feasible for high temeparture energy applications.With the excellent electrical, magnetic and mechanical properties wither coated on metallic substrates or in bulk. The prompt response of these materials towards extrenal stinulus makes them suitable for applications of sensors, actuators, energy harvesting, structural health monitering, piezocatalysis and piezo-nano generators[1-3].

References

1. Habib, M.S., et al., *Improved sintering and impedance studies of CuO-doped multiferroic (0.98Ba0.85Ca0.15) (Zr0.1Ti0.9)·O30.02BiFeO3 ceramics.* Applied Physics A, 2022. **128**(3): p. 238.
2. Kim, D.W., et al., *Material aspects of triboelectric energy generation and sensors.* NPG Asia Materials, 2020. **12**(1): p. 6.
3. Habib, M.S., et al., *Experimental determination of electrophoretic deposition parameters and electrical characterization for K 0.5 Na 0.5 NbO3 perovskite thick films for energy harvesting applications.* Materials Chemistry and Physics, 2024. **316**: p. 129074.

Development and Characterization of MOF-Silane Composite Coatings for Adsorption Heat Pump Applications

Muhtadi Idrees[1], Antonio Fotia[1], Emanuela Mastronardo[1], Luigi Calabrese[1]

[1] Department of Engineering, University of Messina, Contrada di Dio Sant'Agata,98166, Messina, Italy

*Correspondence: muhtadi.idreesmohamedahmedabdallah@studenti.unime.it

ABSTRACT

Metal-Organic Framework MIL-100(Fe) demonstrates remarkable water adsorption capacity, S-shaped water vapor uptake, and low desorption temperature, making it suitable for adsorption heat pump technology. However, its low thermal conductivity, due to large pore size and high porosity, limits heat transfer efficiency. This can be enhanced by coating heat exchangers with adsorbent material[1].

MIL-100(Fe) have been synthesized by hydrothermal method at 160 ºC for 12h, The physiochemical characterisations confirm the synthesis of crystalline MIL-100(Fe) [2]. Aluminium Al6061 has been chosen as a substrate for coating. The ratio of silane solution is: Ethanol/water/Silane 90/5/5% v/v. Before preparation of the composite coating, the pure MIL-100(Fe) was functionalised by a *N*-propyl-trimethoxy silane (50/50% wt/wt MOF vs silane solution) to reduce the surface hydroxyl groups and favour the next crosslinking reaction between MOF and silane matrix. The coating samples were obtained by drop coating method; different concentrations of MOF (50 wt% to 80 wt%) have been prepared. Considering the applied functionalization treatment, the final ratio of MOF filler was in the range 25-40 wt%. Dynamic vapor sorption (DVS) analyser measured the water vapor sorption capacity of the MOF and composite coatings MOF/Silane. The mechanical and adhesive properties of coatings have been investigated by pull-off and scratch tests. Furthermore, contact angle measurements were used to assess the hydrophobicity , and evaluate the surface homogeneity of the MOF/Silane coating.

The water adsorption isobars measured at 12.3 mbar. All the adsorbent coatings presented the S-shaped adsorption curve within a narrow temperature window. In the pure MOF sample, the maximum uptake is 27 wt %. For the coated MIL-100(Fe) samples, the water adsorption capacity of adsorbent coating is far lower than pure MIL-100(Fe), composite coating with MOF at 25 wt.% reaches maximum water uptake 7 wt.%, while the 10wt.% was the maximum water uptake for silane-MOF coating with 40 wt% of filler. The results showed good agreement with the actual percentage of MOF in the coating. In addition, the adhesion properties of the coating performed by pull-off were good. The best results have been obtained for coating with a lower content of MOF (25 wt.%) which shows a pull-off adhesion strength of 1.7 MPa. The hydrophobic behaviour of the MOF silane coatings have been verified from the contact angle measurements (contact angle between 105° and 119°). The good results, in terms of mechanical stability, liquid water hydrophobicity and sorption capacity make this class of composite sorbent coatings suitable for adsorption heat pump applications. Further improvements in coating preparation and performance optimization are needed.

References

1. Freni, A. et al. SAPO-34 coated adsorbent heat exchanger for adsorption chillers. Appl Therm Eng 82, 1–7 (2015).

2. Horcajada, P. et al. Synthesis and catalytic properties of MIL-100(Fe), an iron(III) carboxylate with large pores. Chemical Communications 2820–2822 (2007) doi:10.1039/b704325b.

Synthesis, characterization and *In-vitro* investigation of the activity of Doxorubicin-loaded PLA-based nanofibers

Natavan Ismayilova[1,2*], Songul Ulag[2,3,4], Ali Sahin[5], Firat Baris Barlas[6], Erol Ince[1], Oguzhan Gunduz[2]

[1]Istanbul University-Cerrahpasa Engineering Faculty, Chemical Engineering Department, Avcilar-Istanbul, Turkey

[2]Center for Nanotechnology & Biomaterials Application and Research (NBUAM), Marmara University, Istanbul, Turkey

[3]Faculty of Technology, Marmara University, Department of Metallurgical and Materials Engineering, Istanbul, Turkey

[4]Health Institutes of Türkiye (TUSEB), Istanbul, Turkey

[5]Department of Biochemistry, School of Medicine/Genetic and Metabolic Diseases Research and Investigation Center, Marmara University, Istanbul, Turkey

[6]Istanbul University-Cerrahpasa Institute of Nanotechnology and Biotechnology, Buyukcekmece-Istanbul, Turkey

*Correspondence: nataone.chem@gmail.com

ABSTRACT

Cancer is characterized by abnormal and uncontrolled cell growth resulting from genetic or epigenetic changes in somatic cells, with the ability to spread to other parts of the body. It continues to rank as the most significant health issue after cardiovascular diseases [1] . Despite significant progress in both diagnosis and treatment, the prevalence and fatality rates of cancer persistently escalate, underscoring the urgent need for innovative approaches in combating this formidable disease. The nano-oncological paradigm stands out as one of the most efficacious methodologies in contemporary cancer therapeutics.

The primary objective of synthesizing poly(lactic acid) (PLA)-based nanofibers loaded with Doxorubicin, an antineoplastic chemotherapy agent, is to enhance the drug's pharmacokinetic profile. Doxorubicin possesses a relatively short elimination half-life of approximately 34.7 ± 16.6 hours [2], which may limit its therapeutic efficacy due to rapid clearance from the body. By encapsulating Doxorubicin within PLA nanofibers, the aim is to prolong its presence within the systemic circulation and ensure sustained release over an extended duration, thereby improving its therapeutic effectiveness against cancerous cells.

In this study, pure and Doxorubicin loaded PLA nanofibers were synthesized by electrospinning method. Optimization of parameters such as flow rate, polymer concentration, voltage, distance was performed in fiber formation [3] .

Synthesized nanofibers characterized by FTIR, XRD, DSC, SEM analysis, and cell viability against A549 lung cancer was examined by MTT assay at 24 hours.

The SEM results indicate that the nanometer-scale fibers exhibit a free-beaded, continuous, and uniform structure, with an increase in fiber diameter from 372 nm to 434 nm upon Doxorubicin loading.

Additionally, significant improvements were achieved in in vitro release of DOX from nanofibers in phosphate buffer solution (PBS) at pH = 7.4 and 24-h MTT results.

References

1. Saini, A.; Kumar, M.; Bhatt, S.; Saini, V.; Malik, A. CANCER CAUSES AND TREATMENTS. *Int J Pharm Sci Res* **2020**, *11*, 3121, doi:10.13040/IJPSR.0975-8232.11(7).3121-34.
2. Robert, J.; Bui, N.B.; Vrignaud, P. *European Journal of Clinical Pharmacology Pharmacokinetics of Doxorubicin in Sarcoma Patients*; 1987; Vol. 31;.
3. Ding, J.; Zhang, J.; Li, J.; Li, D.; Xiao, C.; Xiao, H.; Yang, H.; Zhuang, X.; Chen, X. Electrospun Polymer Biomaterials. *Prog Polym Sci* 2019, *90*, 1–34.

Synthesis and Characterization of Iron Oxide Nanoparticles for Sustainable and Efficient Water Purification

Nayab Raza[1], Aneela Anwar[1*], Mariam Sohail Mansoor[1], Furqana Bibi[1]**

[1] Department of Chemistry
University of Engineering and Technology, Lahore, Pakistan
**Correspondence: nayabraza298@gmail.com
*Correspondence: a.anwar@uet.edu.pk

ABSTRACT

Globally, water pollution is increasing due to the rapid expansion of industrial activity and human population. The major contribution of heavy metals (Pb, Cd, and Cr) can be extremely toxic and contribute significantly. Advancements in nanotechnology have opened new doors for efficient and cost-effective heavy metal extraction from water. In this study, bared Iron Oxide Nanoparticles (IONPs) and EDTA-coated IONPs were synthesized using guava extract to remove heavy metals (Cr and Pb) from wastewater. Several analytical approaches were used to characterize the IONPs. The XRD (X-ray diffraction) study confirmed the crystallinity of IONPs, with a crystal size of 18.21 nm. *UV*-Vis *spectroscopy revealed* a peak at 334 nm, while FTIR (Fourier transform infrared) spectral analysis indicated OH, C-H, and S=O functional groups, confirming the biomolecules responsible for biogenic synthesis and stability. The surface morphology of the biogenic IONPs was studied using SEM (scanning electron microscopy), which indicated a nearly "spherical" and "cubic". The contributing factors of contact time, pH, initial metal ion concentrations, and IONP dosage were investigated influencing Cr and Pb ion adsorption. The results of this work indicate that plant-mediated IONPs are effective adsorbents for removing Pb and Cr from contaminated aqueous solutions [1-4].

References

1. Wu, W., Q. He, and C. Jiang, *Magnetic iron oxide nanoparticles: synthesis and surface functionalization strategies.* Nanoscale research letters, 2008. **3**: p. 397-415.
2. Kumar, M., et al., *Guava (Psidium guajava L.) leaves: Nutritional composition, phytochemical profile, and health-promoting bioactivities.* Foods, 2021. **10**(4): p. 752.
3.Yilmaz Camoglu, A., D. Ozdes, and C. Duran, *Adsorption behaviour of EDTA modified magnetic Fe3O4 coated brewed tea waste on Cr (VI) removal.* Chemistry Africa, 2023. **6**(2): p. 921-931.
4. Kaleem, M., et al., *Biogenic synthesis of iron oxide nanoparticles and experimental modeling studies on the removal of heavy metals from wastewater.* Journal of Saudi Chemical Society, 2024. **28**(1): p. 101777.

The Enhancement of Hydroxyapatite's Inhibitory Properties of Steel Through a Grafting Reaction with Phenolic Compounds in NaCl 3%

Nouhaila Ferraa[1*], Mzioud Khaoula[2], Moussa Ouakki[1,3], Mohammed Cherkaoui[1,3], Mounia Bennani Ziatni[1]

[1]Materials, Electrochemistry and Environment team; Organic Chemistry, Catalysis and Environment Laboratory, Faculty of Science, Ibn Tofail University, PB. 133-14050 Kenitra, Morocco.

[3]Laboratory of Advanced Materials and Process Engineering, Faculty of Sciences, University Ibn Tofail PB. 133- 14000, Kenitra, Morocco.

[3] National high school of chemistry (ENSC), Ibn Tofail University, PB. 133-14050 Kenitra, Morocco.

*Correspondence: nouhaila.ferraa@uit.ac.ma

ABSTRACT

The extensive use of solutions as cooling fluids in certain industries has led to significant corrosion challenges, demanding prompt solutions. A commonly adopted strategy by industries and researchers alike is to modify the corrosive environments by introducing low-concentration inhibitory substances to the aggressive medium. In the current study, we focused on enhancing the inhibitory properties of hydroxyapatite (HAp), through a grafting reaction with phenolic compounds extracted from garlic. Hydroxyapatite is widely recognized for its biocompatibility and similarity to bone structure, making it a promising material for various applications, including corrosion inhibition. By grafting phenolic compounds onto hydroxyapatite, we aimed to improve its corrosion inhibitory performance, thereby providing a more effective and sustainable solution to corrosion-related issues in industries. The modified products were thoroughly characterized using chemical analysis (CA), infrared absorption spectroscopy(FTIR) and X-ray diffraction (DRX) . These analyses confirmed the successful attachment of phenolic compounds to the surface of the grafted phosphates, validating the effectiveness of the grafting reaction. The presence of these phenolic compounds on the surface of the modified hydroxyapatite enhances its ability to inhibit corrosion, offering a promising solution to the prevalent corrosion problems caused by cooling fluids in industrial applications.The results of this study have significant implications for the development of new corrosion inhibitors. The optimal concentration required for the modified hydroxyapatite was found to be half that of the initial phosphates (HAp). Specifically, the concentration was reduced from 100 ppm to 50 ppm for the modified HAp. This reduction in concentration not only reduces the cost but also minimizes the environmental impact of the inhibitor, making it a more sustainable option for corrosion prevention. Moreover, the inhibitory efficiencies of HAp-EA were 93.3% at 50 ppm compared to the initial phosphates (HAp) which were 91.3 % at 100 ppm. These impressive inhibitory efficiencies demonstrate the potential of the modified hydroxyapatite-based inhibitors in providing long-term corrosion protection for steel.

References

1. **N. Ferraa**, M. Ouakki, H. El Harmouchi, M. Cherkaoui, M. Bennani Ziatni, *« Investigation of the inhibition behavior of an octacalcium phosphate as a greencorrosion inhibitor against carbon steel in 3 % NaCl medium »* Inorganic Chemistry Communications (2023) 157, https://doi.org/10.1016/j.inoche.2023.111343
2. **N. Ferraa,** M. Ouakki, M. Cherkaoui, M. Bennani Ziatni, « Synthesis, Characterization and Evaluation of Apatitic Tricalcium Phosphate as a Corrosion Inhibitor for Carbon Steel in 3 wt% NaCl ». J Bio Tribo Corros (2022) 8, 23, https://doi.org/10.1007/s40735-021-00622-4
3. **N. Ferraa**, M. Ouakki, M. Barbouchi, M. Cherkaoui, M. Bennani Ziatni, *« Theoretical investigation and Electrochemical study of stoichiometric Hydroxyapatite as an ecofriendly corrosion inhibitor for steel in 3% NaCl »* Biointerface Research in Applied Chemistry Volume 14, Issue 3, 2024, 54, https://doi.org/10.33263/BRIAC143.054

Fabrication of Zinc Oxide Thin Films by Sol-Gel Dip Coating Process

Oloruntoba Sola Omodele[1,3 *], Zulkarnain Zainal[1,2, *], Yusran Sulaiman[1,2] and Ruzniza Mohd Zawawi[1]

[1]Department of Chemistry, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia. *Correspondence: zulkar@upm.edu.my, oloruntobasola4@gmail.com

[2]Nanomaterials Synthesis and Characterization Laboratory, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor. Malaysia.

[3]Department of Chemistry, Faculty of Science, Federal University of Agriculture, P.M.B. 2373, Makurdi, Benue State, Nigeria

ABSTRACT

Zinc oxide (ZnO) is a non-toxic compound with distinct physical and chemical properties. It has a direct band gap energy of 3.37 eV and, a large binding energy of 60 meV with significant thermal and chemical stability at room temperature. As an important oxide in laboratory applications, it has numerous functions such as UV light emitters, transparent conducting thin films in electronic devices, gas-sensor, piezoelectric material, transducers, and transparent conductive oxide (TCO) layer in thin film photoelectrochemical cells.

Different methods of fabrication such as pulsed laser deposition (PLD), hydrothermal method, molecular beam epitaxy (MBE), sol-gel method, chemical vapour deposition (CVD), magnetron sputtering technique, and metal-organic chemical vapour deposition (MOCVD) have been utilized in obtaining ZnO thin films. However, most of these methods require expensive experimental set-up, high vacuum, and high temperature. In this regard, the sol-gel process is one of the most convenient, cheaper, and most applicable methods for ZnO thin film fabrication due to its simplicity, low crystallization temperature, easy reproducibility, homogeneity at the molecular level, and accurate compositional control. Therefore, this study deposited ZnO thin films on Indium Tin Oxide (ITO) glass substrates by using a sol-gel dip coating method under varying preparative parameters: sol precursor concentration of 0.1 M – 0.4 M and annealing temperature (300 °C – 400 °C) with zinc acetate dehydrate, diethanolamine and ethanol as precursors. The fabricated films were annealed at a heating rate of 2 °C/min for 1 h.

The samples were characterized by UV-visible spectrophotometer, X-ray diffraction (XRD), Field emission scanning electron microscopy (FESEM), and Energy dispersive X-ray spectroscopy (EDX) analysis. The results confirmed that the unique properties of ZnO thin films are strongly dependent on the preparative parameters. The band gap energy decreased from 3.25 to 3.18 eV with an increase in the sol precursor concentration from 0.1 to 0.4 M. The bandgap energy also decreased with the annealing temperature from 300 °C to 400 °C. XRD patterns indicate smaller full width at half maximum of the most intense peak (0 0 2) at higher sol precursor concentration and annealing temperature, indicating increment in the crystallite size. The FESEM images reveal various morphological changes with the increase in the sol precursor concentration and annealing temperature. The EDX confirms the formation of highly pure ZnO thin films on the ITO glass substrates.

Macromolecular Chemistry Versatile Tool for Improving the Self-Assembly Skills of Commercial Coatings

Paul Valentin LOVIN[1], Ana-Maria ALBU[1]*, Iulia NEBLEA[2] Ioana Cătălina GÎFU[2], Bogdan TRICA[2]; Cristian Andy NICOLAE[2]

[1]Faculty of Chemical Engineering and Biotechnologies, Department of Bioresources and Polymer Science; National University of Science and Technology Politehnica Bucharest, 1–7 Gh. Polizu Street, Bucharest 011061, Romania,

[2]National Research & Development Institute for Chemistry and Petrochemistry, ICECHIM, Spl. Independentei nr. 202, 060021, Bucharest, Romania;

*Correspondence:paul_valentin.lovin@stud.chimie.upb.ro;anamaria.albu@upb.ro;

ABSTRACT

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

Biopolymer-Based Food Packaging: Techniques for Incorporating Functional Ingredients and Enhancing Food Quality

Pir Mohammad Junaid[1], Sadaf Zaidi[1*]

[1]Department of Post Harvest engineering and technology, Aligarh Muslim University, Aligarh, India, 202002; *Correspondence: sadaf.phet@gmail.com

ABSTRACT

Biopolymer-based food packaging materials exhibit variable properties depending on their source, structure, preparation technique, and degree of crosslinking. The method of incorporation affects the porosity, compactness, and surface rearrangement, requiring consideration of material compatibility and sensitivity to external factors. Efficient incorporation of functional ingredients into polysaccharide films can be achieved through solvent casting, extrusion, hydrocolloid gelation, electrospinning, encapsulation, and emulsion coating. Understanding the chemistry of the ingredients and polymers is crucial for selecting the appropriate method. Incorporating bioactive compounds within biopolymer packaging protects these substances, addresses their limitations, enhances their effectiveness, and enables novel food products. Solvent casting is a widely used, reliable, and versatile technique for producing biopolymer-based packaging films that enables the incorporation of functional ingredients. Electrospinning is used for fabricating polymer films and nanofibers, offering advantages like continuity, cost-effectiveness, and the ability to incorporate heat-sensitive ingredients. Food coatings provide an extra layer of protection and preservation, formulated with bioactive ingredients to enhance shelf life and quality. The coating act as barriers to external factors and help retain food properties, making them a cost-effective option for reducing post-harvest issues. This study examines the significance of leveraging various incorporation techniques to enable the use of diverse functional ingredients in food packaging applications.

References

1. Othman, S. H., Kahar, N. S., Nordin, N., & Ahmad Shapi'i, R. (2023). Properties and Food Packaging Applications of Solvent Casting-Made Starch-Based Films Incorporated with Essential Oils: A Review. Starch - Stärke, 75(5–6), 2200152.
2. Junaid, P. M., Saikumar, A., Nazim, M. S., Zaidi, S., Badwaik, L. S., & Ahmad, F. (2024). Film-Based Packaging for Food Safety and Preservation: Issues and Perspectives. In *Microbial Biotechnology in the Food Industry: Advances, Challenges, and Potential Solutions* (pp. 429–446). Springer
3. Munteanu, B. S., & Vasile, C. (2021). Encapsulation of Natural Bioactive Compounds by Electrospinning—Applications in Food Storage and Safety. *Polymers*, *13*(21), 3771.
4. Li, J., He, J., Huang, Y., Li, D., & Chen, X. (2015). Improving surface and mechanical properties of alginate films by using ethanol as a co-solvent during external gelation. *Carbohydrate Polymers*, *123*, 208–216.

5. Khan, O. A., Zaidi, S., Islam, R. U., Naseem, S., & Junaid, P. M. (2023b). Enhanced shelf-life of peach fruit in alginate based edible coating loaded with TiO2 nanoparticles. *Progress in Organic Coatings*, *182*(May), 107688.

The Influence of Temperature on the Structure and Properties of TiZrTaAg High Entropy Alloy

Radu Nartita[1,*], Andrei Bogdan Stoian[1], Daniela Ionita[1], Ioana Demetrescu[1,2]

[1]Department of General Chemistry, Faculty of Chemical Engineering and Biotechnologies, University Politehnica of Bucharest, 313 Splaiul Independentei, 060042 Bucharest, Romania

[2] Academy of Romanian Scientists, 3 Ilfov, 050044 Bucharest, Romania;

*Correspondence: nartita.radu@gmail.com

ABSTRACT

High-entropy alloys (HEAs) represent a paradigm shift in alloy design, characterized by their unique multi-component compositions [1,2]. This presentation focuses on the TiZrTaAg [3] high-entropy alloy and explores the intricate relationship between its structure and properties. Unlike conventional alloys that emphasize one or two principal elements, HEAs like TiZrTaAg consist of four or more elements, leading to distinctive structural and functional characteristics.

Our study investigates the microstructural attributes of TiZrTaAg using Atomic Force Microscopy (AFM) and X-ray Photoelectron Spectroscopy (XPS) analyses, with a particular emphasis on the effects of thermal treatments. Samples of TiZrTaAg have been exposed to various temperatures (control, 300°C, 500°C, and 800°C) to study the influence of heat treatment on their microstructure and properties. Preliminary AFM data suggest a complex surface morphology that varies with temperature, potentially correlating with the alloy's high mixing entropy and its resultant phase stability. XPS analyses will further elucidate the electronic states and oxidation states of the constituent elements, offering a deeper understanding of the surface chemistry and its implications on material performance.

Additionally, we evaluate the mechanical properties of TiZrTaAg through Vickers hardness testing, providing a quantitative measure of the alloy's hardness and its resistance to deformation under different thermal conditions. This will help to elucidate how thermal treatments influence the mechanical properties, potentially leading to enhanced performance in extreme environments. The interplay between the alloy's microstructure, influenced by thermal treatments, and its mechanical properties will be discussed, highlighting how the high entropy effect and thermal history affect both phase formation and mechanical behavior.

This study aims to shed light on the fundamental aspects of high-entropy alloy design and the role of thermal treatments, contributing to the broader understanding of HEAs.

References

1. Nartita, R.; Ionita, D.; Demetrescu, I. A Modern Approach to HEAs: From Structure to Properties and Potential Applications. Crystals **2024**, 14, 451. https://doi.org/10.3390/cryst14050451

2. Dongyue, L.; Peter, K.L.; Lu X.; Yong Z.; Wenrui W. Advanced high-entropy alloys breaking the property limits of current materials. Journal of Materials Science & Technology **2024**, 186, 219-230. https://doi.org/10.1016/j.jmst.2023.12.006
3. Vasilescu, E.V.; Calderon, M.J.M.; Vasilescu, C.; Drob, S.I.; Stanciu, D.E.; Ivanescu, S.; Ionita, M.D.; Prodana, M. Ti-Zr-Ta-Ag Bio-alloy for Orthopedic Implants OSIM. Bucuresti. Patent 132031, 30 April 2019

Carbon Nanomaterial Based Drug Delivery Systems and Applications

Reyhan Yanıkoğlu[1*], Cem Bülent Üstündağ[1,2],

[1]Department of Bioengineering, Faculty of Chemical and Metallurgical Engineering, Yıldız Technical University, İstanbul, Turkey

[2]Health Biotechnology Joint Research and Application Center of Excellence, 34220 Esenler, Istanbul, Turkey

*Correspondence: reyhanyanikoglu@gmail.com

ABSTRACT

Based on the structural representation of various 0-, 1-, 2-, and 3-dimensional carbon nanomaterials with sp^2 and sp^3 hybridization allotropes existing in distinct crystallographic forms, it can be understand that carbon nanomaterials/allotropes comprise a collection of materials that vary primarily in terms of structure, morphology, and properties, but share carbon as the primary constituent of their forms. Generally speaking, carbon's remarkable capacity to connect with other atoms and convert from sp^2 to sp^3 hybridization is driven by its chemical diversity, particularly by its catenate ability. This supports the idea that carbon is one of the most remarkable elements in the Periodic Table and that it is essential to life as we know it [1].

With the discovery of carbon nanomaterials, the research and development of these materials in biomedical applications is increasing rapidly. With their special and adjustable qualities, these materials—which include single-walled and multi-walled carbon nanotubes as well as carbon nanofibers—have uses in a range of industries, including electronics, health, and the environment [2].

Owing to its exceptional chemical, mechanical, electrical, and thermal characteristics, carbon nanostructures have been used recently in a wide range of fields, such as energy storage and conversion, composite materials, sensors, drug delivery, electronics, and field emission devices.

Numerous studies on carbon-based nanomaterials (CBNs) have been carried out with increasing interest. However, because of the wide range of possible impacts on the environment and human health, their applications are restricted. Making an informed decision on the diverse carbon-based nanocarrier system and its prospective applications can be confusing for researchers. The novel uses and state-of-the-art developments of CBNs in drug delivery have been emphasized in this review study. This study has covered a few crucial elements, including surface modification, enzymatic breakdown, biological interactions, and bio-corona. These elements will aid in the creation of CBNs for efficient medication delivery. In order to enhance the treatment of disease, this study also discusses recent developments in carbon-based target-specific and release-controlled drug delivery. These CBNs have shown unique biological interactions because of their nanosize and variety of physical characteristics. Therefore, before moving on to clinical use, a lengthy preclinical toxicity investigation is advised by scientists [3].

Keywords: carbon nanomaterials, nanotechnology, biomedical applications, drug delivery systems

References

1. Nasir, S., Hussein, M. Z., Zainal, Z., & Yusof, N. A. (2018). Carbon-based nanomaterials/allotropes: A glimpse of their synthesis, properties and some applications. Materials, 11(2), 295.

2. Wanekaya, A. K. (2011). Applications of nanoscale carbon-based materials in heavy metal sensing and detection. Analyst, 136(21), 4383-4391.

3. Debnath, S. K., & Srivastava, R. (2021). Drug delivery with carbon-based nanomaterials as versatile nanocarriers: progress and prospects. Frontiers in Nanotechnology, 3, 644564.

Development of Hydroxyapatite-Based Drug Delivery Devices Loaded with Doxorubicin for the Treatment of Breast Cancer

Reyhan Yanıkoğlu[1*], Sahar Dinparvar[2], Adil Allahverdiyev[3], Cem Bülent Üstündağ[1,4]

[1]Department of Bioengineering, Faculty of Chemical and Metallurgical Engineering, Yıldız Technical University, İstanbul, Turkey, *Correspondence: reyhanyanikoglu@gmail.com

[2]CEITEC, Brno University of Technology, Czech Republic

[3]The V. Akhundov National Scientific Research Medical Prophylactic Institute, Baku, Azerbaijan

[4]Health Biotechnology Joint Research and Application Center of Excellence, 34220 Esenler, Istanbul, Turkey

ABSTRACT

Because of its chemical resemblance to the mineral found in bones, hydroxyapatite (HA) is a bioceramic that has been extensively researched. Its biocompatibility, bioactivity, and thermal stability in bodily fluids make it a desirable material for a variety of biomedical applications. The synthesis of particles of this material has been the subject of numerous attempts, with the goal of precisely controlling the dimensions, shape, porosity, and surface area. HA is frequently employed in drug-controlled release formulations, as well as an implant for bone tissue regeneration and as a covering for metallic implants [1].

One of the most popular chemotherapeutic drugs for treating a variety of malignancies is doxorubicin, often known as Adriamycin. It produces reactive oxygen species, forms DNA adducts, inhibits topoisomerase II, evicts histones, regulates Ca2+ and iron hemostasis, and overproduces ceramides, among other intracellular targets, to cause cell death. Furthermore, doxorubicin facilitates the immune system's removal of malignant cells. But its broad application has been weakened by the emergence of chemoresistance and cardiotoxicity side effects [2].

In this study, a novel drug delivery method was created to shield the patient from the negative effects of chemotherapy during the duration of their breast cancer treatment. Two distinct processes were used to create doxorubicin-loaded hydroxyapatite (HA-DOX) and doxorubicin-loaded hydrothermal hydroxyapatite (HHA-DOX). Eight distinct kinds of analysis were used to characterize every drug delivery system. The MTT assay was used to conduct cytotoxicity experiments on the breast cancer cell line MCF-7. As part of the characterization studies, the samples' bonds were examined using FTIR, their surface charges were ascertained using zeta potential, their phase structures were determined using XRD, their specific surface areas were observed using BET, and their thermal behavior was investigated using TG-DTA analysis. Additionally, MTT assays were conducted to investigate the MCF-7 breast cancer cell line's fatal effect. Observations from the characterization studies showed that DOX is successfully loaded HA.

Also, according to the data obtained from cell culture tests, HA-DOX was found to be the most effective drug delivery system.

Keywords: breast cancer, hydroxyapatite, doxorubicin, drug delivery systems

References

1. Gomes, D. S., Santos, A. M. C., Neves, G. A., & Menezes, R. R. (2019). A brief review on hydroxyapatite production and use in biomedicine. Cerâmica, 65, 282-302.
2. Sritharan, S., & Sivalingam, N. (2021). A comprehensive review on time-tested anticancer drug doxorubicin. Life sciences, 278, 119527.

Docetaxel-Loaded Polymer-Coated Iron Oxide Nanoparticles Intended for Prostate Cancer Treatment

Romesa Soomro[1] and Che Azurahanim Che Abdullah[1,*]

[1]Physics Department, Faculty of Science, Universiti Putra Malaysia, 43300, Selangor, Malaysia

*Correspondence: Azurahanim@upm.edu.my

ABSTRACT

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

Nanotechnology Based Medical Devices: Potentialities and Regulation

Rupak Kumar [1,*]

[1]ICMR, New Delhi, India

*Correspondence: rupakraman@mail.com

ABSTRACT

Medical device as a multiproduct sector has an enormous potential to become self-reliant for contribute towards the goal of universal health care. This sector is continuously being leveraged with the development of technologies and softwares that accomplish medical device's performance and evaluation with great efficiency and precision which ultimately saving time, effort and resources. In this context, regulatory compliances are emerging and evolving that forever enable strengthening the healthcare ecosystem particularly for the prevention, diagnosis, treatment and management of all medical conditions, diseases, illnesses, and disabilities. In the growing medical device market, more innovations and novel are envisaged from technologies like wearable devices, leveraging 5G based medical technology, 3D printing devices, minimally invasive devices, etc. Many of these technologies based medical devices (implantable or not) include nanomaterials through either surface coating or by lithography. In this article, several medical devices are identified that are floating in market in various health domains such in wound healing, prevention or treatment of infectious diseases, cardio-vascular diseases, organ or joint replacement, and others implants for their possible risk, interaction with the organism (positive or negative via toxicity/biocompatibility studies) as well as regulatory specific to India.

Tailored Electrophoretic Coatings for Enhanced Corrosion Resistance of 316L Stainless Steel Implants using Bioactive Glasses

Salwa El Baakili*, Abdelhabib Semlali, Hawraa Issa, Meriame Bricha, Khalil El Mabrouk

Euromed University of Fes, UEMF, Morocco, 30030 Fes, Morocco

*Correspondence: s.elbaakili@femg.ueuromed.org

ABSTRACT

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

Green route Concoction and Characterization of MgO Nanoparticles and Guesstimate of their Antimicrobial Activity

Sambandam Thamizharasan [1*], Karuppasamy Gurunathan [2]

Nano Functional Materials Lab, Department of Nanoscience and Technology, Science Campus, Alagappa University, Karaikudi, 630003, Tamilnadu(State), India.

Email: thamizh25msc@gmail.com

ABSTRACT

Nanotechnology offers a innovative possibility for biotic applications through altering the physical, chemical properties of materials. Herein task, plentiful NPs have been revealed in up-to-date years to be effective in contrast to various microbes, together with antibiotic-resistant microbes. Bacterial trash is a prodigious jeopardy for humanoid health. Nanotechnology helpful to develop novel inorganic antibacterial mediators. Metal oxide nanoparticles has a possible to diminish bacterial infection and contamination. MgO is an imperative inorganic oxide and has been extensively used in countless fields. Various studies have made known that MgO nanoparticles partake better antibacterial activity. There are diverse methods used for chemical route synthesis of various nanoparticles such as pyrolysis, precipitation, micelle, sol-gel, and hydrothermal procedures concentrate it toxic and danger to the human ecology and environment. To minimalize this undesirable effect on the human and environment, green route synthesis turn out to be a saver. Green synthesis is one of the broadly used, cost-effective, and non-hazardous method for the preparation of unpretentious metal oxides. In the existing study, magnesium oxide nanoparticles have been synthesized using *Avicennia marina* leaf extract and the antimicrobial activity of MgO nanoparticles was crisscross in contrast to human pathogens such as Staphylococcus aureus, Escherichia coli, and *Pseudomonas aeruginosa*. For the green synthesis of MgO nanoparticles, 10 g of the *Avicennia marina* leaf powder was mixed with 100 mL distilled water and placed in the shaker incubator at 150 rpm up to 5h and the the solution was sieved and the filtrate was cast-off for nanoparticle synthesis. 3 mM $MgNo_3$ was added to 50 mL extract and boiled to 100°C for 30m and the color changes from green to brown was observed. It indicating the formation of nanoparticles. The brown color semi- solid got by evaporation was calcined at 500°C and used for structural and functional analysis. The size, morphology of the formed MgO nanoparticles were determined by using UV- Spectroscopy, XRD, SEM and TEM. Antimicrobial activity of MgO nanoparticles were evaluated by well diffusion method. The photosensitive castoffs of a Mgo nanoparticle strappingly depends arranged size, shape and interaction of particles existing on the surface plasmon. The captivation of absorbance spectra of MgO nanoparticles recorded the range 200–800 nm. The XRD was executed to study the crystalline phase, structure, size and purity of the sample. It shown peaks at (1 1 1), (2 0 0) (2 2 0), (4 0 0), and (3 1 1) planes correspondingly. The diffraction peaks were in accordance with the JCPDS No. 87–0653 exhibiting poly crystalline spherical structure. The particle sizes premeditated with Scherrer's formula stayed nearby 10 nm. By using SEM, the MgO nanoparticles exhibit spherical structured particles. The TEM image long-established that the size of the MgONPs was 10 nm. Besides, TEM image boons the spherical edifice of the green synthesized MgO nanoparticles. The antimicrobial

activity of MgONPs against pathogenic bacterial strains and their zone of inhibition were compared with standard antibiotic penicillin. This study's outcomes showed that antimicrobial activity at par with zone of inhibition against pathogens such as *Staphylococcus aureus*(14mm), *Escherichia coli*(17mm), and *Pseudomonas aeruginosa* (12mm) were observed. Based on the results it was confirmed that, the synthesized MgONPs might have feasible applications due to their good catalytic activity, stout antioxidant and antimicrobial properties.

Keywords: Avicennia marina; nanoparticles; antibacterial activity; ihibition zone; metal oxide.

Investigation of the effect of maleic anhydride grafted polyethylene compatibilizing agent in industrial lime sludge waste filled HDPE composites

Satadru Kashyap[1]

[1] Department of Mechanical Engineering, Tezpur University, Napaam, Sonitpur District, Assam (India) - 784028

*Correspondence: satadru@tezu.ernet.in

ABSTRACT

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

New Polymer-Modified Ti-alloy with Potential Application as Stent in Coronary Surgery

Stefan Sandu[1], Doïna-Margareta Gordin[2], Denis Laillé[2], Sandrine Geffroy[2], Vera Balan[1], Liliana Verestiuc[1]

[1] Faculty of Medical Bioengineering, Grigore T. Popa University of Medicine and Pharmacy of Iasi, 700115, Romania

[2] INSA Rennes, UMR CNRS 6226 SCR/Chimie-Métallurgie, 20 avenue des Buttes de Coësmes, F-35043 Rennes Cedex, France

*Correspondence: sandu.stefan@email.umfiasi.ro

ABSTRACT

According to the World Health Organization, coronary artery disease (CAD), a disease that is characterized by the deposition of cholesterol, fats, calcium, and other substances in the arteries, continues to be the leading cause of death worldwide. A feature of CAD is thrombus formation in the flowing blood and the artery blockage [1]. Coronary artery disease where plaques are deposited in the inner lining of an artery is known as atherosclerosis, and the main causes are represented by: unhealthy diet, physical inactivity, obesity, high blood pressure, diabetes, tobacco and harmful alcohol consumption.

Balloon angioplasty was the first treatment used to treat atherosclerosis [2]. Although it is minimally invasive procedure with low cost, in small coronary artery or completely obstructed, the balloon cannot move beyond the blockage. Nowadays, one of the most widely used therapeutic approaches for CAD is self-expanding stent-based interventional surgery, and involve advanced stents based on shape-memory materials, based on metallic alloys. Such stents provide mechanical support to the blood vessel wall, restoring physiological blood flow. To improve the implant's hemocompatibility, various modifications were practiced on self-expanding stent surface and the most common techniques include spray coating, dip coating or electrospinning [3].

In this regard, the aim of the present study was to synthesise a new Ni-free biocompatible titanium alloy with memory shape property, to evaluate the ability of this material to be manufactured as vascular stents and to functionalize its surface with a natural polymer, albumin. The modification of the alloy surface was carried out in 2 steps: initially a porosity was created on the metal surface thanks to a Piranha acid mixture, and then a biopolymer was deposited by the dip coating technique.

The microstructure of the new alloy was characterized by the XRD technique and optical microscopy. The mechanical characterization was carried out using simple and cyclic tensile tests and Vickers hardness measurements. The roughness before and after biopolymer deposition was evaluated by confocal microscopy and AFM. SEM technique was used to characterise the morphology of the biopolymer thin layer.

The obtained results show that the synthetised titanium alloy has a good shape memory and the biopolymer thin layer improves the surface hydrofilicity.

References

1. Yihong Shen et al. Development of Biodegradable Polymeric Stents for the Treatment of Cardiovascular Diseases. Biomolecules 2022, 12, 1-20.
2. Navideh Abbasnezhad et al. An Overview of In Vitro Drug Release Methods for Drug-Eluting Stents. Polymers 2022, 14, 1-24.
3. Maciej Kozlik et al. Drug-Eluting Stents: Technical and Clinical Progress. Biomimetics 2023, 8, 1-16.

Development and Characterization of Biomaterials Using Electrospinning Method

Sude Göktuğ[1,2], Tubanur Avcı[1,2], Canan Doğan[1,2], Oğuzhan Gündüz[1,2]

[1]Center for Nanotechnology & Biomaterials Application and Research (NBUAM), Marmara University, Turkey

[2]Department of Metallurgical and Materials Engineering, Faculty of Technology, Marmara University, Turkey

*Correspondence: canan.dogan@marmara.edu.tr

ABSTRACT

The use of biomaterials is extremely important because they are compatible with the body, support tissue repair, and increase the effectiveness of medical treatments. The electrospinning method enables the creation of nanofiber structures in biomaterial production, providing an ideal matrix for cell adhesion, proliferation, and tissue engineering applications. Electrospinning is a one-step, economical, and versatile technique used to produce nano- and micro-scale fibers. Fibers produced with this technique have attracted attention in many areas, especially biomedical applications, thanks to their many unique functions, including high surface area/volume ratio, flexibility, and high porosity.

In this study, chitosan (CS) and polyethylene oxide (PEO) copolymers and bacterial cellulose (BC) nanofibers were developed by the electrospinning method. BC is a pure biopolymer synthesized by some bacteria and, unlike natural cellulose, it has features such as high purity and superior mechanical properties. Thanks to its nanofibril structure, high crystallinity, and large surface area, BC stands out as an important material in biomedical applications. Moreover, although its biocompatibility makes it an ideal material, it is not suitable for nanofiber production by electrospinning alone. The high viscosity and strong hydrogen bonds of BC prevent the formation of thin, continuous, and uniform fibers required during electrospinning. Chitosan offers antimicrobial properties as a natural polymer, while PEO reduces viscosity and stabilizes the solution to facilitate the electrospinning process. This combination enables the development of CS/PEO/BC nanofibers suitable for the electrospinning process while maintaining the advantages of BC.

Scanning electron microscopy (SEM) was used to view the morphology of the developed fibers, Fourier transform infrared (FTIR) analysis was used to obtain information about the molecular structure, differential scanning calorimetry (DSC) was used to determine their thermal properties, and tensile analysis was used to determine their mechanical strength. To determine their antimicrobial properties, the nanofibers were tested on *S. aureus* and *E. coli* bacteria. Fiber structures were observed according to SEM analysis. According to FTIR analysis, the presence of the polymers used was shown in the structure of the developed fiber. DSC results show that the melting points are close to each other when comparing CS/PEO and CS/PEO/BC fibers. When the tensile test results were examined, it was seen that nanofibers containing BC in their structure had higher strength values. Antimicrobial test results have proven that it has antimicrobial properties. In conclusion, the nanofiber developed in this study is a potentially suitable candidate for biomedical applications.

References

1. Azarniya, A., Eslahi, N., Mahmoudi, N., & Simchi, A. (2016). Effect of graphene oxide nanosheets on the physico-mechanical properties of chitosan/bacterial cellulose nanofibrous composites. Composites Part A: Applied Science and Manufacturing, 85, 113-122.
2. Lima, G. D. M., Sierakowski, M. R., Faria-Tischer, P., & Tischer, C. A. (2009). Characterization of the bacterial cellulose dissolved on dimethylacetamide/lithium chloride.

Harnessing the Power of Nature: Applications of Essential Oils Across Diverse Fields

Sunita Singh*, Avanish Chandra Sharma

Department of Chemistry, Navyug Kanya Mahavidyalaya Lucknow, University of Lucknow India
*Correspondence: deptofchemistrynkmv@gmail.com

ABSTRACT

Essential oils, derived from plant extracts, are increasingly recognized for their therapeutic benefits across various industries. These natural compounds are obtained through steam distillation or cold pressing, capturing the plants' aromatic essence and bioactive molecules. Their complex chemistry enables a range of biological activities, notably antimicrobial, antioxidant, and anti-inflammatory effects [1,2].

In healthcare, essential oils serve as natural alternatives for treating respiratory infections, skin conditions, and digestive issues. Their antimicrobial properties are effective against bacteria, viruses, and fungi, while their antioxidant capabilities combat cellular damage from free radicals. Additionally, the anti-inflammatory properties of essential oils help soothe pain and reduce inflammation.

The cosmetic and personal care sectors utilize essential oils for their fragrant qualities and health benefits. They are key components in skincare products, perfumes, and aromatherapy solutions, enhancing both the sensory experience and therapeutic value

In the food and beverage industry, essential oils are employed as flavor enhancers, preservatives, and antimicrobial agents, contributing to the safety and quality of food products.

Agriculturally, essential oils act as eco-friendly pest repellents and plant growth promoters, offering a sustainable alternative to synthetic chemicals.

Ongoing research continues to uncover the vast potential of essential oils. Understanding their molecular actions is vital for maximizing their therapeutic applications. As the body of evidence grows, essential oils stand poised to offer innovative solutions across multiple sectors [1,2,3,4]

References:

1. Guedri Mkaddem Mounira, "Essential Oils and Their Bioactive Molecules: Recent Advances and New Applications," IntechOpen, 2024.
2. Jesus M. Rodilla et al., "Essential Oils: Chemistry and Food Applications," Foods, 2024.
3. Irina Neta Gostin and Irinel Eugen Popescu, "Evaluation of the Essential Oils Used in the Production of Biopesticides," Agriculture, 2024.
4. Yuru Chang et al., "Biocontrol Potential of Essential Oils in Organic Horticulture Systems," Frontiers in Nutrition, 2022.

Hyaluronic Acid/Ellagic Acid as Materials for Potential Medical Application

Sylwia Grabska-Zielińska[1], Beata Kaczmarek-Szczepańska[2], Konrad Kleszczyński[3], Lidia Zasada[2], Dorota Chmielniak[2], Mara Barbara Hollerung[3], Katarzyna Dembińska[4], Krystyna Pałubicka[5], Kerstin Steinbrink[3], Maria Swiontek-Brzezinska[4]

[1]Faculty of Chemical Technology and Engineering, Bydgoszcz University of Science and Technology, Seminaryjna 3, 85-326 Bydgoszcz, Poland

[2]Department of Biomaterials and Cosmetics Chemistry, Faculty of Chemistry, Nicolaus Copernicus University, Gagarin 7, 87-100 Toruń, Poland

[3]Department of Dermatology, University of Münster, Von-Esmarch-Str. 58, 48149 Münster, Germany

[4]Department of Environmental Microbiology and Biotechnology, Faculty of Biological and Veterinary Sciences, Nicolaus Copernicus University in Torun, Lwowska 1, 87 100 Torun, Poland;

[5]Department of Conservation and Restoration of Paper and Leather, Nicolaus Copernicus University, Sienkiewicza 30/32, 87-100 Toruń, Poland

*Correspondence: sylwia.grabska-zielinska@pbs.edu.pl

ABSTRACT

For numerous years, the exploration of natural polymers in biomedical contexts has been propelled by their remarkable biocompatibility and biodegradability [1]. To date, hyaluronic acid (HA) is one of the most wellknown and commonly used biopolymer in wound dressing application. It is a high molecular weight compound made up of repeating units of D-glucuronic acid and N-acetyl-D-glucosamine linked by alternating β-1,4 and β-1,3 glycosidic linkages. HA plays a crucial role in wound healing by keratinocyte migration, remodeling of extracellular matrix (ECM), and stimulating fibroblast proliferation [2]. Ellagic acid (4,4′,5,5′,6,6′-hexahydroxydiphenic acid 2,6,2′,6′-dilactone, EA) is a polyphenol renowned for its anticancer and excellent antioxidant properties as well as antibacterial activity and UV-barrier properties. It is effectively used as a modifier in films based on chitosan, apple starch or sodium alginate targeting food packaging applications as well as dietary supplement in powder, liquid forms, or capsules [3].

The aim of this work was to develop and characterize thin films composed of hyaluronic acid/ellagic acid for potential medical application. Ellagic acid was dissolved in two different solvents, i.e. acetic acid (AcOH) or sodium hydroxide (NaOH) and the surface properties of the resultant films were assessed using atomic force microscopy and contact angle measurements. Additionally, various physicochemical parameters were evaluated. Furthermore, evaluation of films' biocompatibility was conducted using human epidermal keratinocytes, dermal fibroblasts, and human amelanotic melanoma cells and the antimicrobial activity was elucidated. Our results show that the films exhibited prominent antibacterial properties. This

experimental approach could be a promising technique for future applications in regenerative dermatology or the novel strategies in terms of bioengineering [4].

References

1. George, A.; Sanjay, M.R.; Srisuk, R.; Parameswaranpillai, J.; Siengchin S., *Int. J. Biol. Macromol.* **2020**, 154, 329-338.
2. Sahana, T.G.; Rekha, P.D., *Mol. Biol. Rep.* **2018**, 45, 2857–2867
3. Shahidi, F.; Ambigaipalan, P., *J. Funct. Foods* **2015**, 18, 820–897
4. Kaczmarek-Szczepańska, B.; Kleszczyński, K.; Zasada, L.; Chmielniak, D.; Hollerung, M.B.; Dembińska, K.; Pałubicka, K.; Steinbrink, K.; Swiontek-Brzezinska, M.; Grabska-Zielińska, S., *Int. J. Mol. Sci.* **2024**, accepted

New Biotechnologies for the Purification of Phycobiliproteins with Antibacterial and Antifungal Effect

Trofim Alina, Rudacova Angela

Moldova State University, SRL Phycobiotechnology, Chișinău, Republic of Moldova
Correspondence: alinatrofim@yahoo.com

ABSTRACT

As demonstrated by our previous research, phycobiliproteins obtained from cyanobacteria are important substances with anticancer and antibacterial effect. An efficient procedure was developed for their extraction, isolation and purification. The freeze-thaw method was found to be the most effective. Several solvents were also used, namely: In the first stage, a 0-20% SA saturation was used. After centrifugation, a greenish precipitate was obtained, indicating the partial removal of chlorophyll from the extract. Subsequently, other successive stages of fractionation followed: 20-40% SA; 40-60% SA.

These fractionation steps were absolutely necessary to remove ballast proteins from the extract. The degree of purification of individual fractions was determined by a coefficient expressing the ratio of optical densities at two wavelengths: A620/A280 for phycocyanin or A560/A280 for phycoerythrin. In the extract, this coefficient is 0.1-0.5. This value corresponds to a phycobiliprotein content of 5-10% of the total protein. In 100% pure phycocyanin, this indicator is 4.8. To use the phycocyanin preparation in the food industry, the A620/A280 ratio must be at least 2, which corresponds to a phycobiliprotein main substance content of 40%.

The value of the purification coefficient A620/A280 for sediments of 40 and 60% was determined not to exceed 2. To obtain a better result, it was necessary to perform an additional purification using the hydrophobic chromatography method. Some preliminary experiments were performed to select suitable media. Phenyl Sepharose CL-4B, Butyl Sepharose 4 fast flow, and Octyl Sepharose CL-4B columns were used. As the best result, it was obtained after performing chromatography on Butyl Sepharose 4 fast flow being selected for subsequent purifications. So the pure fraction was obtained which has the ratio of 3.89. Phycobiliproteins were tested in Turkey at the University of Burdur and demonstrated an anticancer effect.

Spectral characteristics of some isolated fractions obtained after purification phycobiliproteins from the biomass of the cyanobacterium *Calothrix marchica*

The analyzed fraction	A_{280}	A_{620}	Diluția	A_{620}/A_{280}
The summary extract	0.735	0.075	12	0.102
The analyzed fraction 60% $(NH_4)_2SO_4$	0.416	0.506	26	1.22
The peak after chromatography on butylsepharose	0.096	0.208	13.5	0.17
Fraction No. 5 resulting after chromatography	0.084	0.327	26	**3.89**

Antibacterial and Anticancer Effect of Cyanobacteria

Trofim Alina, Balan Greta, Rudic Valeriu

Moldova State University, SRL Phycobiotechnology, Chișinău, Republic of Moldova
Correspondence: alinatrofim@yahoo.com

ABSTRACT

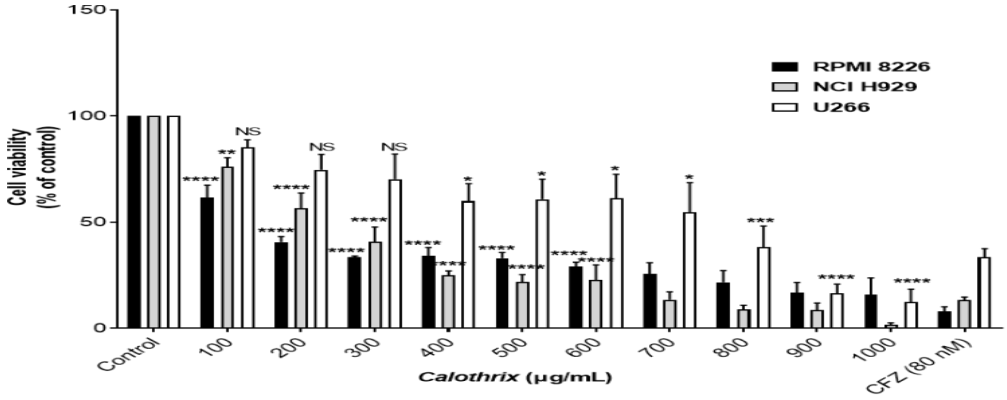
For the qualitative screening of the antimicrobial activity of the studied compounds, the well method was used, standardized for the control of antimicrobial activity and proposed by the CLSI standard (eng. Clinical&Laboratory Standards Institute).

The extracts used in the experiments were obtained from the cyanobacteria separated from the environment, washed with distilled water and pr5in the addition of 30% ethyl alcohol according to the methodology. After adding the biomass, the alcohol concentration became 25%, which was the control sample for comparison with the bacterial samples.

Biological compounds proven to be active on gram-negative bacilli strains were selected for further testing by the method of successive dilutions to determine the MIC (Minimum Inhibitory Concentration) and CMB (Minimum Bactericidal Concentration).

Following the results obtained, we found that all three compounds showed bactericidal and bacteriostatic action on gram-negative strains in the 1:3 dilution, and the control (25% alcohol) demonstrated bactericidal and bacteriostatic effect in the 1:1 dilution. Bactericidal and bacteriostatic activity of biological compounds on gram-negative bacteria (*Escherichia coli* ATCC25922; *Acinetobacter baumannii* ATCC BAA-747)

On gram-positive bacteria, these three compounds also showed bactericidal and bacteriostatic activity in the 1:3 dilution, and the control (25% alcohol) demonstrated bactericidal and bacteriostatic effect in the 1:2 dilution Antimicrobial action of natural compounds on gram-positive bacteria (*Staphylococcus aureus* ATCC 25923; Bacillus cereus ATCC 11778). The tested compounds showed antifungal activity in lower concentrations compared to the antibacterial effect. The fungistatic effect was demonstrated in the 1:5 dilution, and the fungicidal effect was manifested in the 1:4 dilution. The control (25% alcohol) demonstrated fungicidal and fungistatic effect in 1:3 dilution Fungicidal and fungistatic activity of biological compounds (*Candida albicans* ATCC 10231) From the graph below, the anticancer effect of *Calothrix marcica* cyanobacteria extracts is evident



So, as we can see the researched extracts show antifungal and antibacterial and anticancer action.

Development and Characterization of Biomaterials by Adding Henna Using Electrospinning Method

Tubanur Avcı[1,2], Emre Uygur[1,2], Canan Doğan[1,2], Oğuzhan Gündüz[1,2]

[1]Center for Nanotechnology & Biomaterials Application and Research (NBUAM), Marmara University, Turkey

[2]Department of Metallurgical and Materials Engineering, Faculty of Technology, Marmara University, Turkey

*Correspondence: canan.dogan@marmara.edu.tr

ABSTRACT

Health issues and increasing environmental pollution encourage scientists to investigate and develop new biomaterials designed to have positive contributions to human health with minimal negative impact on the environment. The electrospinning method plays a significant role in the production of materials that stand out with biological compatibility and biodegradability. This method, offering advantages such as economic viability, ease of use, high surface area, and controlled morphology, holds great importance in biomaterial development.

In this study, the preparation of Lawsonia Inermis (henna) extract, known for its traditional wound healing properties and proven antibacterial effects, with poly(ethylene oxide) (PEO), chitosan, and bacterial cellulose using the electrospinning method was investigated. PEO is a polymer that facilitates the formation of nanofibers, acts as a carrier matrix, and enhances mechanical strength by providing flexibility to the nanofibers. Chitosan, which possesses natural antimicrobial properties, serves as a biocompatible and biodegradable polymer that, in addition to PEO, provides antimicrobial properties and biocompatibility. Bacterial cellulose is a biocompatible polymer with high mechanical strength and water-holding capacity. The combination of these materials aims to achieve superior performance in terms of flexibility, mechanical strength, and antimicrobial properties.

The morphological, mechanical, thermal, and chemical evaluations of the produced CS/PEO/BC/henna nanofibers were conducted using SEM, DSC, tensile testing, and FT-IR analysis. SEM results demonstrated clear visibility of the fibers. CS/PEO/BC-based electrospun fibers containing henna extract were verified by the appearance of FTIR peaks consistent with the pure extract. Tensile test results revealed a slight decrease in tensile strength with the addition of henna extract. Antimicrobial tests were conducted to determine the in vitro efficacy of henna extract against S. aureus and E. coli, and MTT analysis was performed to measure cell viability and cytotoxicity results. DSC results indicated similar thermal stability between CS/PEO/BC and CS/PEO/BC/henna fibers, confirming the integration of henna into the overall matrix of the fibers. These findings demonstrate the suitability of CS/PEO/BC/henna nanofibers for potential biomaterial development.

References

1. Yousefi, I., Pakravan, M., Rahimi, H., Bahador, A., Farshadzadeh, Z., & Haririan, I. (2017). An investigation of electrospun Henna leaves extract-loaded chitosan based nanofibrous mats for skin tissue engineering. Materials Science and Engineering: C, 75, 433-444.
2. Avci, H., Monticello, R., & Kotek, R. (2013). Preparation of antibacterial PVA and PEO nanofibers containing Lawsonia Inermis (henna) leaf extracts. Journal of Biomaterials Science, Polymer Edition, 24(16), 1815-1830.

The *In Vivo* Effects of Indigenous Biologically Active Compounds on Liver Biochemical Markers in Blood Plasma of Rats

Valeriana Pantea[1*], Cristina Popușoi[1], Marina Reabîșeva[1], Mariana Jian[3], Ecaterina Pavlovschi[2], Inna Șveț[1], Oxana Nicolaeva[1], Veaceslav Popa[2]

[1]Laboratory of Biochemistry, *Nicolae Testemitanu* State University of Medicine and Pharmacy, Chisinau, Republic of Moldova

[2]Department of Biochemistry and Clinical Biochemistry, *Nicolae Testemitanu* State University of Medicine and Pharmacy, Chisinau, Republic of Moldova

[3]Laboratory of tissue engineering and cell cultures, *Nicolae Testemitanu* State University of Medicine and Pharmacy, Chisinau, the Republic of Moldova

*Correspondence: valeriana.pantea@usmf.md

ABSTRACT

Thiosemicarbazones (TSCs) represent a class of Schiff bases typically synthesized through the condensation of thiosemicarbazide with aldehydes or ketones. These compounds have garnered considerable interest among chemists and biologists due to their diverse pharmacological properties. Notably, TSCs are potent metal chelators and have shown promise as anticancer agents. In clinical diagnostics, the activity levels of transaminases (aminotransferases), specifically alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in blood serum or plasma, serve as sensitive widely used indicators of tissue damage and, in particular, liver toxicity. However, elevated transaminase levels do not invariably correlate with hepatotoxicity, as they may rise in response to drug- or disease-induced hepatocellular injury. This study investigates the impacts of administering copper-coordinating TSC derivatives—designated as TIA-3, CMT-67, and TIA-160—on aminotransferase enzymes in blood plasma *in vivo*, although the detailed biochemical mechanisms of these compounds remain largely undefined. While plasma liver enzyme elevations are typically employed as markers for hepatic damage in rats, the hepatotoxic potential of these specific TSC derivatives has yet to be fully clarified.

The research results demonstrate that the administration of copper thiosemicarbazones coordination compounds (CCTs) TIA-3 and CMT-67 to male groups resulted in a decrease in alanine aminotransferase (ALT) levels by 9-19%. Conversely, TIA-160 exhibited a statistically significant reduction in ALT by 13% compared to the control group, establishing these CCTs as reliable markers for detecting liver diseases. Simultaneously, AST activity in the TIA-3 treated group aligned with control levels, whereas CMT-67 displayed a marginal decrease of 3% ($p > 0.05$). TIA-160, however, prompted a notable increase in AST by 7% compared to controls. In female subjects, the impact of these compounds varied; TIA-3 led to a significant 38% decrease in ALT levels. CMT-67 maintained ALT levels consistent with the control group, while TIA-160 showed an increase of 15% in ALT ($p < 0.05$). AST levels decreased by 40% with TIA-3 and CMT-67 administration, with a slight decrease of 3% ($p < 0.05$), and an 11% increase in the TIA-160

group relative to control values. Overall, the CCTs primarily exhibited reductions in both ALT and AST levels, except for TIA-160, which showed a tendency to increase transaminase activity. This selective influence may reflect the distinct antiproliferative and cytotoxic effects of these compounds on liver cells, suggesting potential therapeutic applications in liver-related conditions.

References

1. Rosu T., Gulea A., Nicola A., Georgescu R. Complexes of *3d*(n) metal ions with thiosemicarbazones: synthesis and antimicrobial activity. Molecules. 2007 Apr 17; 12(4): 782-96. doi: 10.3390/12040782. PMID: 17851430; PMCID: PMC6149331.
2. Senior J. R. Alanine aminotransferase: a clinical and regulatory tool for detecting liver injury-past, present, and future. Clin Pharmacol Ther. 2012 Sep; 92(3): 332-9. doi: 10.1038/clpt.2012.108. Epub 2012 Aug 8. PMID: 22871997.

Production of Biomaterial with Controlled Drug Release System Developed with Hybrid System for Laryngeal Cancer Treatment

Yaren Inal*, Fatma Ozdemir, Yagmur Kazancioglu, Sude Toptas

Yıldız Technical University, Istanbul, Turkey
*Correspondence: yaren.inal@std.yildiz.edu.tr

ABSTRACT

Before this project proposal was created, a detailed literature review was conducted on the treatment methods applied for tumor types seen in laryngeal cancer. Laryngeal cancer is a common type of cancer caused by factors such as smoking, tobacco and alcohol. In laryngeal cancer, surgical intervention is essential to remove the tumor and prevent its spread. Current treatments include chemotherapy and radiotherapy. However, these applications and their alternative applications have various disadvantages. 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 new malignant cell formation is prevented. Thus, metastasis is prevented. Thanks to these effects, it is a promising study for the treatment of laryngeal cancer.

The basic principle of the controlled drug delivery system is to release the active drug into the specified tissue in the body at certain time intervals at doses regulated for the patient. In this study, it is aimed to place a hybrid drug delivery system loaded with chemotherapeutic drugs, painkillers and antibiotics created by Electro-spinning and 3D printing techniques in the tumor area removed from the larynx by surgical procedure in order to prevent the formation of a new tumor. The difference of the release system design described in the project proposal from other common release systems can be explained by two points: The first of these is the aim to use a hybrid system in the design of the biomaterial. In classical and widely used release systems, only 3D printing or only Electro-spinning is preferred. In this project proposal, 3 layers containing different drugs and loaded with different techniques are designed. These layers will be created by Electro-spinning and 3D printing methods. Another difference is that in the project proposal, instead of meeting only the chemotherapy needs of the patient, it is aimed to load the system with painkillers and antibiotics as well as chemotherapeutic drugs, taking into account the conditions such as fever and pain that may occur due to cancer.

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, collaborations can be made with countries working in the fields of tissue engineering and bioengineering, especially Japan and European countries.

References

1. American Cancer Society , What Are Laryngeal and Hypopharyngeal Cancers? , January 19, 2021, Online.
2. Luraghi, A., Peri, F., & Moroni, L. *Electrospinning for drug delivery applications: A review. Journal of Controlled Release, 334, 463–484.* 2021
3. L. Vaut, G. Zeng, G. Tosello, ve A. Boisen, "Sacrificial Polymer Substrates in Photopolymerization-Based Micro 3D Printing for Fabrication and Release of Complex Micro Components", *Adv Mater Technol*, c. 4, sy2019

Analyzing the Conductivity and Dielectric Properties of Carbon Nanofibres Reinforced Polyvinylidene Fluoride Composite Films

Y. Nioua [1*], V. M. Serrato[2], A. Triki [3], A. J. Paleo[4*], Z. Samir [1], N. Aribou [1], M. Hdidar[3], M. Arous[3], K. Lozano[5] and M. E. Achour [1]

[1]Laboratory of Material Physics and Subatomic, Faculty of Sciences, Ibn Tofail University, BP 242, 14000 Kenitra, Morocco

[2]Florida Institute of Technology, Melbourne, Florida, USA

[3] LaMaCoP, Faculty of Sciences of Sfax, University of Sfax, BP 3018, Sfax, Tunisia.

[4]2C2T – Centre for Textile Science and Technology, University of Minho, Campus de Azurém, 4800-058 Guimarães, Portugal

[5]Department of Mechanical Engineering, University of Texas Rio Grande Valley, Edinburg, TX 78539, United States.

Email: Yassine.nioua@uit.ac.ma, ajpaleovieito@2c2t.uminho.pt

ABSTRACT

Dielectric properties of carbon nanofibres (CNFs)-reinforced polyvinylidene fluoride (PVDF) composites were investigated in the temperature range from -60°C to 150°C and frequency range from 0.1Hz to 10^6 Hz. These composites were melt-mixed with different contents of carbon nanofibres (CNFs) (0, 2.5, 5, 7.5, 10, 12.5 and 15 wt. %).

The CNFs content variation is taken into account in this dielectric analysis in order to investigate its effect on the molecular mobility of the PVDF matrix chains. Hence, three dielectric relaxation processes were identified for the neat PVDF and its PVDF/CNFs composites according to the electric modulus formalism and the Kramers-Kronig equation. The first one, appearing in the temperature range from -50°C to 20 °C and the frequency range from 5 Hz to 10^6 Hz is associated with the α_a relaxation originating from the glass transition of the PVDF matrix. Whereas, the second one appearing at lower frequencies and higher temperatures is attributed to the α_c dielectric relaxation originating from the molecular motions occurring within the crystalline region of PVDF. As for the third dielectric relaxation process, appearing at high temperatures from 60°C to 150°C and at low frequencies is identified to the interfacial polarization effect (IP). This latter originates from charge accumulation at amorphous/crystalline interface in at PVDF. The introduction of CNFs into PVDF matrix gives rise to an additional interfacial polarization effect occurred by charge accumulation at CNFs/PVDF interface. Analysis of either the activation energy or the intensity of all these dielectric relaxations allows probing the CNFs effect on the molecular dynamic of PVDF matrix.

Keywords: Dielectric relaxations, PVDF nanocomposites, Havriliak-Negami model, Molecular dynamic.

References

1. Y. Nioua et al, Analysis of the dielectric relaxation in reduced graphene oxide/epoxy composites materials using the modulus formalism. The European Physical Journal E. 44 (9) 2021.
2. S. Larguech, A. Triki, M. Ramachandran, A. Kallel. Dielectric Properties of Jute Fibers Reinforced Poly(lactic acid)/ Poly(butylene succinate) Blend Matrix. Journal of Polymers and the Environment. 29(1):1-17 (2021)

Gelatin Methacryloyl (GELMA) Microneedles for Localized Delivery of Antiepileptic Drugs Loaded on Bismuth Ferrite (BFO) and Polylactic-co-Glycolic Acid (PLGA) Particles

Yeliz Guldorum[1,2], Sule Ilgar[1,3], Zekiye Akdag[1,4], Esra Pilavci[1,4], Songul Ulag[1,5], Emine Alarcin[6], Ayse Akkaya[6], Banu Aydin Omay[7], Zehra Kanli[7], Oguzhan Gunduz[1,5*]

[1]Center for Nanotechnology & Biomaterials Application and Research (NBUAM), Marmara University, Istanbul, Turkey, ***Correspondence:** ucemogu@ucl.ac.uk

[2]Department of Biomedical Engineering, Electrical and Electronics Faculty, Yıldız Technical University, Istanbul, Turkey

[3]Department of Bioengineering, Faculty of Chemistry and Metallurgy, Yildiz Technical University, Istanbul, Turkey

[4]Institute of Pure and Applied Sciences, Metallurgical and Materials Engineering, Marmara University, Istanbul, Turkey

[5]Department of Metallurgical and Materials Engineering, Faculty of Technology, Marmara University, Istanbul, Turkey

[6]Department of Pharmaceutical Technology, Faculty of Pharmacy, Marmara University, Istanbul, Turkey

[7]Department of Biophysics, School of Medicine, Marmara University, Istanbul, Turkey

ABSTRACT

Epilepsy has been prevalent as a neurological disorder since 4000 BC and continues to be one of the most common conditions in modern times. According to 2019 data from the World Health Organization (WHO), epilepsy affects approximately 0.7% of the population. Furthermore, around 5 million individuals receive a diagnosis each year. Antiepileptic drugs are effective in managing seizures and achieving successful treatment for epilepsy. Approximately 20-30% of individuals demonstrate pharmacoresistance, and only a minority of these patients will experience favorable outcomes with surgical surgery. Although antiepileptic medications are effective in managing epilepsy crises for 70% of patients, approximately 20-30% of patients exhibit drug resistance. Hence, the development of an effective treatment for the disease remains challenging. To accomplish this objective, antiepileptic drug loaded microneedle (MN) based drug delivery systems can be alternative treatment for epilepsy.

The manner and rate of drug release from polymer matrices are determined by the selection of MN material and specific construction method. Hydrogels have been utilized in the production of MNs due to their excellent biocompatibility and biodegradability. Gelatin methacryloyl (GelMA) is a hydrogel that is made by modifying gelatin with photocrosslinkable methacrylamide groups. It is both biodegradable and biocompatible, and it can be used to deliver cells and biomolecules to specific areas. DLP printers are a useful instrument for producing hydrogels through photo-curing, thanks to their rapid printing speed and high resolution.

In this study, drug loaded bismuth ferrite nanoparticles and polylactic-co-glycolic acid (PLGA) were synthesized by co-precipitation and single emission method, respectively. 3D technique was chosen to produce MNs based on Gelma which was used as the base for biodegradable and biocompatible MNs. Bare and drug loaded MNs were characterized by Fourier Transform Infrared Spectroscopy (FTIR), Differential Scanning Calorimetry (DSC), X-Ray diffraction analysis (XRD) and Scanning Electron Microscopy (SEM). Also, *in vitro* studies of levetirecetam-loaded bismuth ferrite nanoparticles and phenytoin-loaded PLGA nanoparticles loaded GelMA based MN' s were then performed to evaluate drug loading. Biocompatibility testing is performed with human neuroblastoma cells and the results show that the scaffolds are biocompatible with the cells. Given the versatility of GelMA as a material for constructing tissue scaffolds, it is anticipated that 3D-printed GelMA MNs scaffold could serve as a platform for delivering epilepsy treatments.

Keywords: Epilepsy, Gelatin Methacryloyl (GelMA), Bismuth Ferrite Nanoparticles (BFO), Polylactic-co-glycolic acid (PLGA), Tissue Engineering

Acknowledgments: This study was supported financially by TUBITAK with the 23AG008 project number.

References

1. Bonilla, L., Esteruelas, G., Ettcheto, M., Espina, M., García, M. L., Camins, A., ... & Sánchez-López, E. (2022). Biodegradable nanoparticles for the treatment of epilepsy: From current advances to future challenges. *Epilepsia Open*, *7*, S121-S132.
2. Luo, Z., Sun, W., Fang, J., Lee, K., Li, S., Gu, Z., ... & Khademhosseini, A. (2019). Biodegradable gelatin methacryloyl microneedles for transdermal drug delivery. *Advanced healthcare materials*, *8*(3), 1801054.
3. Zhu, J., Zhou, X., Kim, H. J., Qu, M., Jiang, X., Lee, K., ... & Khademhosseini, A. (2020). Gelatin methacryloyl microneedle patches for minimally invasive extraction of skin interstitial fluid. *Small*, *16*(16), 1905910.
4. Zhang, W., Zhang, W., Li, C., Zhang, J., Qin, L., & Lai, Y. (2022). Recent advances of microneedles and their application in disease treatment. *International Journal of Molecular Sciences*, *23*(5), 2401.
5. Ayran, M., Ulag, S., Ervan, S., & Gunduz, O. (2024). Influence of curing time on the experimental and numerical analysis of 3D printed gelatin methacryloyl (GELMA) membranes. *Materials Letters*, *363*, 136316.

E-POSTERS

Effect of Egg White in Biogenic Elaboration of ZnO

Adriana-Gabriela Schiopu[1], Elena Andreea Vijan

[1]Faculty of Mechanics and Technology, National University of Science and Technology POLITEHNICA Bucharest - Pitești University Centre, Targu din Vale, Romania

[2]Science and Materials Engineering Doctoral School National University of Science and Technology POLITEHNICA Bucharest, Romania

*Correspondence: gabriela.schiopu@upb.ro

ABSTRACT

Biogenic synthesis is a technique for producing nanoparticles using biological materials like plants, bacteria, or fungi. Egg white, also known as ovoalbumen, is a readily available and renewable resource that has gained significant interest in biogenic synthesis due to its unique properties.

Egg white can be used as a natural precursor for the elaboration of ZnO nanoparticles. The proteins in egg white can act as templates or capping agents, influencing the size and shape of the resulting ZnO nanoparticles. Zinc ions (Zn^{2+}) from the precursor solution interact with amino acids and other functional groups present in egg white proteins. This interaction leads to the formation of complexes between Zn^{2+} and the protein molecules. During the synthesis process, after involving heating treatment, the egg white undergoes decomposition. This decomposition releases organic molecules that can further influence the morphology and properties of the ZnO nanoparticles.

However, biogenic synthesis using egg white also has some limitations. For example, the size and shape of the nanoparticles can be difficult to control. Additionally, the presence of organic residues from egg white may require further purification steps.

References

1. J. Theerthagiri et al., “A review on ZnO nanostructured materials: Energy, environmental and biological applications,” Nanotechnology, vol. 30, no. 39. 2019
2. S. Jha, R. Rani, S. Singh, “Biogenic Zinc Oxide Nanoparticles and Their Biomedical Applications: A Review”, J Inorg Organomet Polym 33, 1437–1452 (2023)
3. A.G. Schiopu, M. Oproescu, V.G. Iana, C.M. Ducu, S.G. Moga, D.S. Vîlcoci, "Synthesis and Characterization of ZnO-Nanostructured Particles Produced by Solar Ablation, " Materials 16 (19), pp. 6417

Smart Graphene Oxide-based Hydrogels with Photothermal Effect for Wound Healing Applications

Alexa-Maria Croitoru[1,2,3], Anton Ficai[2,4,5*], Roxana Trusca[2], Ludmila Motelica[2], Bianca-Maria Tihauan[1,2,6]

[1]Research Institute of the University of Bucharest (ICUB), University of Bucharest, 0500957 Bucharest, Romania

[2]National University for Science and Technology Politehnica Bucharest, 011061 Bucharest, Romania

[3]National Centre for Food Safety, 060042 Bucharest, Romania

[4]National University for Science and Technology Politehnica Bucharest, 060042 Bucharest, Romania

[5]Academy of Romanian Scientists, 050045 Bucharest, Romania

[6]Research & Development for Advanced Biotechnologies and Medical Devices, SC Sanimed International Impex SRL, 087040 Calugareni, Romania

*Correspondence: anton.ficai@upb.ro

ABSTRACT

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

Variation of the Antioxidant Effect of the Volatile Oil Obtained from *Achillea millefolium* Depending on the Geographical Area

Bogdan Purcăreanu[1,2], Diana Manuela Ene[2], Veronica Drumea[2], Dan Eduard Mihaiescu[3], Anton Ficai[1,4,5]

[1]Department of Science and Engineering of Oxide Materials and Nanomaterials, Faculty of Chemical Engineering

and Biotechnologies, National University of Science and Technology Politehnica Bucharest, 011061 Bucharest, Romania

[2]Biotehnos SA, Gorunului Street 3-5, 075100 Otopeni, Romania

[3]Department of Organic Chemistry "Costin Neniţescu", Faculty of Chemical Engineering and Biotechnologies, National University of Science and Technology Politehnica Bucharest, 011061 Bucharest, Romania

[4]Academy of Romanian Scientists, 3 Ilfov Street, Bucharest, Romania

[5]National Research Center for Micro and Nanomaterials, National University of Science and Technology Politehnica Bucharest, 060042 Bucharest, Romania

*Correspondence: bogdanpb89@gmail.com

ABSTRACT

The genus *Achillea* is one of the most important of the Asteraceae family used in traditional medicine since ancient times and comprises over 100 recognized species and is found in wild flora in Europe, Asia, North America, North Africa, Australia and New Zealand. Due to its antioxidant, anti-inflammatory, antimicrobial and herbicidal properties, the essential oils and extracts obtained from *Achillea Millefolium* are used in areas such as food, pharmaceuticals, cosmetics, perfumery and medicine. This study aims to evaluate the composition and biological action of *Achillea Millefolium* essential oil obtained by hydrodistillation of aerial parts of wild white flowering plant, collected in 2022 from 7 different habitats in Romania. The volatile oils obtained were characterized using gas chromatography-mass spectrometry (GC-MS). Due to the soil, climatic conditions and altitude differences where the plant was harvested, the chemical composition of the volatile oils obtained by hydrodistillation using a neo-clevenger differs both in composition and proportion of components from one region to another. The main components identified in the essential oils obtained areborneol, champhor, thujone, 4-terpineol, eucalyptol, β-pinene, chamazulene, caryophyllene, chrysanthenyl acetate, myrcene and germacrene D.

The biological action of the essential oils was evaluated in terms of antioxidant effect in correlation with their composition, based on the results obtained in the acellular model by DPPH and ABTS stable free radical reduction mechanisms, as well as the evaluation of iron reduction capacity (FRAP).

References

1. Radušienė, J.; Karpavičienė, B.; Raudone, L.; Vilkickyte, G.; Çırak, C.; Seyis, F.; Yayla, F.; Marksa, M.; Rimkienė, L.; Ivanauskas, L., Trends in Phenolic Profiles of *Achillea millefolium* from Different Geographical Gradients. Plants 2023, 12, 746. https://doi.org/10.3390/ plants12040746;
2. Mohammadhosseinia, M., Sarkerb, S. D., Akbarzadeh, A., Chemical composition of the essential oils and extracts of *Achillea* species and their biological activities: A review, Journal of Ethnopharmacology 199 (2017) 257–315;
3. Garzoli, S.; Cicaloni, V.; Salvini, L.; Trespidi, G.; Iriti, M.; Vitalini, S. SPME-GC-MS Analysis of the Volatile Profile of Three Fresh Yarrow (*Achillea millefolium* L.) Morphotypes from Different Regions of Northern Italy. Separations 2023, 10, 51. https://doi.org/10.3390/separations10010051.

Cerium Oxide Nanoparticles: Uses and Perspectives in Nanomedicine

Cezara-Marina Bolocan[1,2], Adrian-Vasile Surdu[1,2,], Roxana Trusca[1,2] , Ovidiu Oprea[1,2], Ecaterina Andronescu [1,2]

[1] National University of Science and Technology POLITEHNICA Bucharest, 011061 Bucharest, Romania

[2]National Research Center for Micro and Nanomaterials, University Politehnica of Bucharest, 060042 Bucharest, Romania

*Correspondence: cezaramarinabolocan@gmail.com

ABSTRACT

Cerium oxide nanoparticles show tremendous potential as biological nanoenzymes due to their remarkable catalytic properties. Ce^{3+} ions and Ce^{4+} ions perform a redox reaction in which they acquire or lose electrons while also producing oxygen vacancies (or defects) into the lattice structure, which can operate as antioxidant enzymes and resemble other enzyme activities. Due to the fact that cerium oxide nanoparticles have low 3+/4+ ion ratios, they have strong catalytic mimetic activity, breaking down H_2O_2, a potentially hazardous oxidizing agent, to produce H_2O and O_2. H_2O_2 is a byproduct of the superoxide created in mitochondria by NADPH oxidases. Previous research has shown that the ability of cerium oxide nanoparticles to display catalytic activities is reliant on a number of particle characteristics, including size and shape. Studies discovered that Ce^{4+} is reduced to Ce^{3+} before being decreased by H_2O_2. Further investigation has found that the bigger Ce^{3+} fraction's smaller surface area improves enzyme-like catalytic activity, which is believed to be dependent on the Ce^{4+} fraction for catalytic activity. The key variables impacting cerium oxide nanoparticles' catalytic activity were examined, and the results revealed H_2O_2 adsorption on the nanoparticles' surfaces. As a result, the surface area to volume ratio of cerium oxide nanoparticles determines their ability to operate as a catalyst. The exceptional catalytic activity of cerium oxide nanoparticles is assumed to be principally generated by an increase in the surface-to-volume ratio.

The aim of this study was to synthesize, characterize bioglass containing cerium ions and employ different biological activities. Moreover, depending on the percentages involved the structure was observed and determined whether it was a mesoporous ordered structure or worm-like structured. Also, the presence of other oxides was observed to be wither a network modifier such as CaO oxide or an important factor to favor Ce^{3+} instead of Ce^{4+}. During this research, bioglass containing Na_2O, CaO and P_2O_5 oxides among cerium were obtained via sol-gel method resulting nanoparticles varying from 6 nm to 10 nm. Characterization employed contained different techniques such as: powder X-ray diffraction, FTIR, scanning electronic microscopy. Further biological analysis is employed on different bioglass containing cerium and the study of of different dopants being added is also under research.

References

1. Khan, M., Sohail, Raja, N.I. *et al.* Antioxidant and hypoglycemic potential of phytogenic cerium oxide nanoparticles. *Sci Rep* **13**, 4514 (2023).
2. Thakur, S.; Patil, P. Rapid synthesis of cerium oxide nanoparticles with superior humidity-sensing performance. Sens. Actuators B Chem. **2014**, 194, 260–268.

Strategies to Obtain PVA Alignment Layers for Nematic Liquid Crystals Used in Biosensing

Cristina-Delia Nechifor[1, *], Marian Luțcanu[1], Alexandra Tamara Sutic[,2]

[1] Dept. of Physics, "Gheorghe Asachi" Technical University of Iași, 700050, 67 Dimitrie Mangeron Blvd., Iasi, Romania,

[2] Faculty of Material Science and Engineering, "Gheorghe Asachi" Technical University of Iași, 70050, 67 Dimitrie Mangeron Blvd., Iasi, Romania

*cd13nechifor@gmail.com

ABSTRACT

Polyvinyl alcohol (PVA) is a hydrophilic polymer with many applications in the industrial field as retarders, polarizers, optical filters, and alignment layers. Because of its biocompatibility, PVA is found in many biomedical applications, including as liquid crystal (LC)-based biosensors. A LC biosensing platform consists of LCs, alignment layers (ALs), and receptors. Because LC molecules follow the alignment imposed by the surface pattern of AL, in this paper we proposed new strategies to modify the surface of PVA thin films to control the NLC orientation

Our previous studies reveal that PVA thin foils with improved anisotropy, without deteriorated physical and chemical properties are obtained when the PVA aqueous solutions were microwave (MW) [1] or ultraviolet (UV) irradiated. Fine or deeper grooves/striations appeared along the stretching direction [2], the films become unidirectionally anisotropic [3] and the adhesion and alignment of LCs are improved. For this study, the films obtained from UV and MW irradiated PVA solutions were modified by scratching with sandpaper than by stretching. The surface of the polymer films was scratched with sandpaper having two different roughness (P1000 and P400). A single turn scratching was performed with a speed of 3 mm/s , keeping a constant contact with the surface of polymer. The rubbing and scratching procedures were done at room temperature and the stretching process was made at a 42-45 ^{0}C. The stretching degree was expressed as the ratio of the semi axes of an ellipse in which a circle drawn on the polymer foil degenerates. This new combined method constitutes a novel and original preparation procedure of alignment layers (Als) for LCs.

The results were evidenced by using ATR-FTIR spectra analysis, contact angle measurements, optical microscopy images, and induced optical birefringence measurements using polarization ellipse method [4]. The adhesion and cohesion interactions between the modified surface of PVA and LCs was evaluated using contact angle technique. Polarized optical microscopy was used to evidence the orientation of LC at the surface of modified PVA films. Parameters as exposure time, stretching degree and roughness of the sandpaper were discussed regarding the used approach to achieve optimal orientation of nematic molecules at the surface of PVA for LC biosensor applications.

References

1. C.-D. Nechifor, M. Aflori, D.-O. Dorohoi, Polymers 11 (2019) 1072-1084.
2. Barzic, R. M. Albu, I. Stoica, C.-D. Nechifor, M. I. Avadanei, D. G. Dimitriu, D.- O. Dorohoi, Polym. Adv. Technol. 35 (2023) 1-11.
3. C.-D. Nechifor, M. Postolache, R. M. Albu, A. I. Barzic, D.-O. Dorohoi, Polym. Adv. Technol. 30 (2019) 2143–2152.
4. M. Postolache, D. G. Dimitriu, C.- D. Nechifor, S. Condurache Bota, V. Cloșca, D.- O. Dorohoi, Polymers 14 (2022) 1063-1074.

This work was supported by a National Research Grants of the TUIASI, project number: GNaC 2023_264 /2024.

Pigment Based Composites with Polyolefin Matrix and Surface Modified Aramid Fibers

Cristina-Elisabeta Pelin[1*], Maria Sonmez[2*], George Pelin[1], Adriana Ştefan[1], Maria Daniela Stelescu[2], Mihai Georgescu[2]

[1] National Institute for Aerospace Research "Elie Carafoli" I.N.C.A.S., 220 Iuliu Maniu Blvd, Bucharest, Romania

[2]The National Research & Development Institute for Textiles and Leather - Leather and Footwear Research Institute Division, 93 Ion Minulescu St., Bucharest, Romania

*Correspondence: pelin.cristina@incas.ro, maria.sonmez@icpi.ro

ABSTRACT

Unmanned aerial vehicles (drones) are used nowadays in an increasing number of applications, from Do-It-Yourself (DIY) hobbies to medical and military sectors. The mass consumption products are generally made of materials that respond to lower quality and resistance requirements, while the highly controlled medical or military drones are generally manufactured from high durability and toughness materials and components. Regarding of use sector, drones are susceptible to encounter potential obstacles on ground level or in the air, such as collisions with different static or moving objects, like flying birds. This can lead to serious damage of the vehicles on structural level of functional level. Therefore, one of the most critical factors in the design of a drone is the materials selection, as they can have a significant impact on the vehicle weight, strength and general performance. Traditionally, drones are manufactured from metals, such as aluminum, however, their high price and weight led to the search for alternatives [1], to achieve performance improvement and longer flight autonomy. The paper presents the development, testing and processing of thermoplastic composites based on polyolefins blend matrix consisting of polypropylene and maleic anhydride grafted polyethylene, with small contents of aramid fibers, previously subjected to surface modification using titanium isopropoxide precursor and microcelullose as TiO_2 particles dimension stabilizer. The composites were processed via melt compounding and thermal pressing. The processability and surface quality of the composites were improved with the use of *Genioplast® Pellet S*, while esthetics and UV resistance were improved with the use of Oppasin Blau® 6900 bleu pigment. The composites were tested in terms of mechanical, thermo-mechanical, impact, contact angle, UV resistance, and morphostructural homogeneity. After complete characterization, the composites were vacuum thermoformed to prove their potential as electronic component covers in small drones destined for commercial or recreational applications. Investigations concluded that the composites exhibited low weight (less than 1 g/cm^3 density values) and good impact strength properties [2], they could be stored at room temperature for extended time periods and processed into products with required design, by vacuum thermoforming at temperatures between 170-180°C using different dimensions, thicknesses and compositions sheets, over molds manufactured from a variety of materials (foams, polymers, metals, wood).

References

1. Palinkas, J. Pekez, E. Desnica, A. Rajic, D. Nedelcu, Analysis and Optimization of UAV Frame Design for Manufacturing from Thermoplastic Materials on FDM 3D Printer, Materiale Plastice, 2022, 58(4), 238-249

2. Pattent Application No. A/00606/26.10.2023, Composite based on polypropylene reinforced with functionalized aramid fibers, M. Sonmez, C-E Pelin, G. Pelin, G-C Cristea, A. Ştefan, M. Nituica, L. Alexandrescu, D. M. Stelescu, M. Georgescu

Acknowledgment

This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS/CCCDI – UEFISCDI, project number 601PED/21.06.2022, within PNCDI III.

Biopolymer Composite Supports, a New Perspective in The Medical Field

Elena Berteanu[1], Iordachel Catalin[1], Maria Paraschiv[1,2], Manoiu Sorin[1], Andreea Iosageanu[1], Enache Mihaela Ionica[1], Alexandrina Rugina[1], Adina-Lidia Zuav[1],

[1]National Institute of Biological Sciences Bucharest, Spl. Independent no. 296, 060042, Bucharest, Romania

2 Politehnica University of Bucharest, Faculty of Mechanical and Mechatronics Engineering, Bucharest, Romania

*Correspondence: email: ***elena.berteanu@incdsb.ro***

ABSTRACT

Introduction. This paper presents a method for the preparation and characterization of chitosan hydrogels (CHI) with plant extracts. *Elaeagnus pungens* extracts are frequently used therapeutically for their anti-inflammatory effect, antioxidant activity, fatty acid, total flavonoids and total phenolic.

In this sense, we prepared aqueous plant extracts (3:150) flower, which we included in the CHI gels.

A major advantage of including these extracts in the hydrogel is that in this way we will take advantage of both the exceptional regenerative properties of the gel and the pharmaceutical properties of the biomass.

Materials and methods. Preparation of CHI gel: 2 g of CHI powder was soaked in 100 mL of 0.005 M CH_3COOH and heated to 50°C until a homogeneous gel was obtained. The obtained hydrogels CHI, have a homogeneous composition, without agglomerated or irregular areas. The hydrogels were coupled with the aqueous *Elaeagnus pungens* in different molar ratios. By drying in the oven, for 72 hours, at 37°C, thin, transparent, elastic biofilms were obtained. They were tested for biocompatibility and SEM. For biocompatibility testing, the indirect contact method was used, determined after 24 hours using the Neutral Red technique on the human keratinocyte HaCaT line.

Results. The results showed that the samples had a viability of 71,7%-22,5%. SEM shows morphological changes induced by the included plant extracts.

Conclusions. The results showed that biomaterials can be considered as promising candidates for biomedical, biotechnological applications.

Keywords: chitosan, aqueous vegetable extract, hydrogel

Acknowledgments: This study was supported by the Ministry Research, Innovation and Digitizations, Nucleu Program, contract 7 N, Project: 23020101/03.01.2024

References:

1. Ahmadiani, A., Hosseiny, J., Semnanian, S., Javan, M., Saeedi, F., Kamalinejad, M. and Saremi, S. (2000) Antinociceptive and anti- inflammatory effects of *Elaeagnus angustifolia* fruit extract. *Journal of Ethnopharmacology*, 72: 287-92.
2. Hassanzadeh, Z. Hassanpour, H. (2018). Evaluation of physicochemical characteristics and antioxidant properties of Elaeagnus angustifolia L. Scientia Horticulturae, 238, 83-90.

Alginate – Pullulan Composites as Candidates for Skin Wound Healing Applications

Emma Bobu[1]*, Klara Magyari[2], Monica Baia[3]

[1]Doctoral School in Physics, Faculty of Physics, Babeș-Bolyai University, M. Kogălniceanu 1, RO-400084, Cluj-Napoca, Romania

[2]Interdisciplinary Research Institute on Bio-Nano-Sciences, Nanostructured Materials and Bio-Nano-Interfaces Center, Babeș-Bolyai University, Treboniu Laurian 42, RO-400271, Cluj-Napoca, Romania

[3]Faculty of Physics, Babeș-Bolyai University, M. Kogălniceanu 1, RO-400084, Cluj Napoca, Romania

* emma.bobu@ubbcluj.ro

ABSTRACT

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

Synthesis of Silver Nanoparticle by Green Synthesis Method for Coating Titanium Surfaces

Fadi Alshaher Alkassar[1], Hussein Majid Sarhan Al Hamadani[1], Abdullah Al Aliwi[1], Zeynep Yıldız Şen[1], Oğuz Atik[1], Ezgi Karalı[1], Güleycan Dedecengiz[1], Sakip Önder[1], Görke Gürel Peközer[1]*

[1]Yıldız Teknik university, Biomedical engineering department, 34220 Istanbul, Turkey
*Correspondence: *gpekozer@yildiz.edu.tr*

ABSTRACT

Titanium and titanium alloys are widely used in orthopedics and dental fields due to their biocompatibility and mechanical properties. However, poor integration of titanium into bone and risks such as infection limit the possibility of success after implantation. For this reason, it is important to provide antibacterial properties to titanium surfaces and increase the bioactivity properties of titanium. Silver coating of titanium surfaces is one of the ways to give antibacterial properties to titanium surfaces. Silver nanoparticles are a widely researched form of silver in the field of biotechnology. Silver nanoparticles can be produced by chemical and physical means, as well as by using plant extracts through green synthesis. The green synthesis method is a non-toxic, non-polluting, cost-effective method.
In this study, it was aimed to synthesize silver nanoparticles through green synthesis and obtain an antibacterial surface by adhering the resulting silver nanoparticles to titanium surfaces. It is also aimed to increase the bioactivity of silver nanoparticle-coated surfaces by soaking them in artificial body fluid (SBF) and precipitating hydroxyapatite on titanium surfaces. In the study, silver nanoparticles were synthesized using currant (Vitis vinifera) extract and these nanoparticles were characterized by UV spectrophotometry, SEM and FTIR methods. Silver nanoparticles, which were determined to be smaller than 100 nm in size by SEM analysis, functional groups were seen at the points of the combination of materials used and synthesized in FTIR, and gave maximum absorbance around 420 nm, were prepared as a solution at a concentration of 60 µg/ml and coated titanium surfaces with electrophoretic method for 40 minutes at 40 Volts. The study was conducted and the results were found to be promising. Optimization studies on this subject continue. Silver nanoparticle coatings on surfaces are expected to increase hydroxyapatite precipitation and osseointegration.

In conclusion, the experiment allows us to get silver nanoparticles using the green chemistry method, a UV-spectra of the wavelengths to confirm the silver existence, FTIR results showing the functional groups in the currants extract and confirms their stabili.

Acknowledgements: we would like to thank TÜBİTAK for granting this study the right to be supported within the scope of 2209-A University Students Research Projects Support Program.

Antimicrobial Composite Packaging Films

Gabriela Petrisor[1,2], Ludmila Motelica[1,2,3*], Denisa Ficai[1,3], Ovidiu Oprea[1,2,3], Anton Ficai[1,2,3], Roxana Trusca[3], Ecaterina Andronescu[1,2,3], Alina Holban[4]

[1]Faculty of Chemical Engineering and Biotechnologies, National University of Science and Technology POLITEHNICA Bucharest, 1-7 Gh. Polizu, 011061 Bucharest, Romania [2]Academy of Romanian Scientists, 3 Ilfov Street, Bucharest, Romania

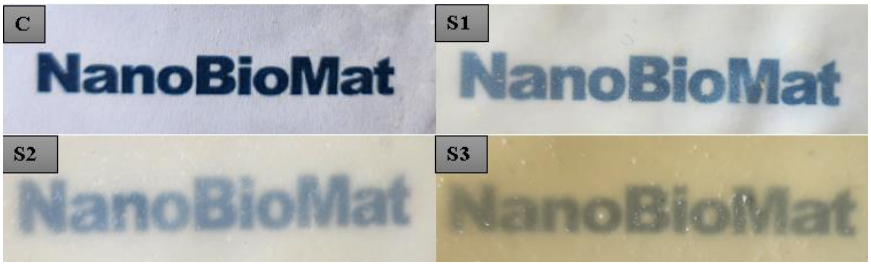
[3]National Research Center for Micro and Nanomaterials, University Politehnica of Bucharest, 060042 Bucharest, Romania

[4]Department of Microbiology and Immunology, University of Bucharest, 077206 Bucharest, Romania

*Correspondence: motelica_ludmila@yahoo.com

ABSTRACT

As antimicrobial resistance becomes a stringent problem of modern society the quest for new strategies to combat bacterial infections is attracting more scientists. One of the best strategies to obtain materials with strong antibacterial activity is to synergistically combine multiple antimicrobial agents. Here we report for the first time the obtaining, characterization and antibacterial properties of a composite material based on cellulose derivatives, antimicrobial nanoparticles and mesoporous silica loaded with cinnamon essential oil (CEO). The obtained cellulose-based films present a strong antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* strains with zone of inhibition up to 26 mm, total inhibition of biofilm development at 24 hours and elimination of bacterial viability after 6 hours. Such antimicrobial cellulose –based f ilms can be used in various biomedical applications as topical dressing or like packaging for food industry.



***Acknowledgments**:* This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CCCDI - UEFISCDI, project number PN-III-P2-2.1-PED-2021-3414, within PNCDI III; 573PED/2022 “Ambalaje inovative cu activitate antimicrobiana pentru siguranta alimentara;

The authors are grateful to the Romanian Government for providing access to the research infrastructure of the National Center for Micro and Nanomaterials through the National Program titled “Installations and Strategic Objectives of National Interest”;

L.M. and G.P. are grateful for the support received from Academy of Romanian Scientists.

References

1. Motelica L, Ficai D, Oprea O, Ficai A, Trusca RD, Andronescu E, et al. Biodegradable Alginate Films with ZnO Nanoparticles and Citronella Essential Oil-A Novel Antimicrobial Structure. Pharmaceutics. 2021;13:1020.
2. Motelica, L., et al., Biodegradable Alginate Films with ZnO Nanoparticles and Citronella Essential Oil—A Novel Antimicrobial Structure. Pharmaceutics, 2021. 13(7): p. 1020.
3. Petrisor, G., et al., Increasing Bioavailability of Trans-Ferulic Acid by Encapsulation in Functionalized Mesoporous Silica. Pharmaceutics, 2023. 15(2): p. 66

Ultrasound-Assisted Synthesis of Silver@Chitosan Nanocomposites and its Photocatalytic Activity

Harekrishna Mahato[1], Brajesh Kumar[1,2, *]

[1]University Department of Chemistry, Kolhan University, Chaibasa-833202, Jharkhand, India
[2]Department of Chemistry, TATA College, Kolhan University, Chaibasa-833202, Jharkhand, India

*Correspondence: krmbraj@gmail.com; krmbrajnano@gmail.com

Abstract

In this work, photocatalytic degradation of methylene blue (MB) dye is reported by utilizing Silver@Chitosan nanocomposites (Ag@C NCs). Synthesis conditions of the Ag@C NCs were optimized by using ultrasonication and gallic acid. Different analytical techniques have been used to characterize the physico-chemical properties of Ag@C NCs. The synthesis of AgNPs was primarily identified by the appearance of yellow colour and confirmed by showing λmax = 415 nm in UV-visible spectroscopy. All characterization techniques reveal that the generated Ag@C NCs were non-aggregated, quasi-spherical shape with an average size of 20-70 nm. Significant degradation (>70%) of MB dye was observed for 5 hrs in sunlight.

References

1. K.Guzmán, B. Kumar, M. J. Vallejo, M. Grijalva, A. Debut, L.Cumbal, Ultrasound-assisted synthesis and antibacterial activity of gallic acid-chitosan modified silver nanoparticles, Progress in Organic Coatings, 129 (2019) 229-235, https://doi.org/10.1016/j.porgcoat.2019.01.009

2. B. Kumar, Green Synthesis of Gold, Silver, and Iron Nanoparticles for the Degradation of Organic Pollutants in Wastewater. J. Compos. Sci. 5 (2021) 219. DOI: 10.3390/jcs5080219.

3. B. Kumar, K. Smita, S. K. Awasthi, A. Debut, L. Cumbal, Capsicum baccatum (Andean Chilli)-assisted phytosynthesis of silver nanoparticles and their H2O2 sensing ability, Particulate Science and Technology, 40 (6) (2022) 772–780 DOI: 10.1080/02726351.2021.2006381

Development of New Biodegradable Polymers for Selected Biomedical Applications

Hend Behour[1,2], Sherif Kandil [1,2,3,*], Labiba El-Khardagui [1,3]

[1]Department of Materials Science, Institute of Graduate Studies and Research, Alexandria University, Egypt

[2]Department of Materials Science, Institute of Graduate Studies and Research, Alexandria University, Egypt

[3]Department of pharmaceutics, Faculty of Pharmacy, Alexandria University, Egypt

Hend.Behour@yahoo.com

ABSTRACT

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

Structural, Optical and Electrical Properties of Spray Deposited Sr Doped SnO_2 Thin Films

Imene Saoula[1], Chahinez Siad [1], Nassiba Allag[1], Nourelhouda Bounedjar [2]

[1] Physics Laboratory of Thin Films and Applications (LPCMA), University of Biskra, 07000, Algeria.
[2]*Renewable Energy Development Unit in Arid Zones (UDERZA), Department of Chemistry, Faculty of Exact* Sciences, University of El Oued, B. P. 789, 39000, Algeria.

ABSTRACT

Transparent conductive oxides (TCOs) are commonly used in many optoelectronic, photovoltaic, and catalytic applications because of their unique optical transparency and electrical conductivity. In this work, the correlation between structural and optical / electrical properties o Sr-doped SnO_2 thin films are presented. Cost-effective spray pyrolysis technique (SPT) was adopted to deposit SnO_2 thin films onto glass substrates heated to 450 °C. The thin films were polycrystalline with a tetragonal rutile-type structure with preferred growth orientation along <110> direction. the highest value of crystallite size 'D' is at 4 wt % (24.257 nm), while in the rest two concentrations of strontium which are 2, and 6 wt % the films' crystallite size decreases and it showing the assimilation of defects whereas an opposite trend was observed for the microstrain 'ε' and the dislocation density 'δ'. From the SEM analysis it is obvious that the three samples have a smooth dense and homogenous surface which confirms the excellent quality of crystallization and their adherence with the substrates [1]. So, a few grains appear at concentration 2 wt % compared to 0 wt % of Sr, while for 4 and 6 wt % the grain are present, but they are very small in size, it almost disappears; in general, the surface morphology of tin dioxide did not improve by the addition of strontium. The transmittance improved along all the visible regions for all the samples of Sr-doped SnO_2 with different concentrations just for 6 wt % of 'Sr' the transmittance decreased slightly compared to pure SnO_2, we can observe the sample of 2 wt % of 'Sr' has the highest transmittance reached to 97% at 700 nm, while for 8 wt % of 'Sr' the transmittance variation represented as a line maybe because it is an amorphous sample, and for the band gap 'E_g' it was decreases slightly from 3.57 eV for the pure tin dioxide film to 2.94 eV for 2 wt % Sr-SnO_2, then it increases rapidly to 3.88 eV and 3.97 eV for 4 and 6 wt % of Sr respectively. For the disorder (E_u) there is always an inverse proportional to the E_g. after four-point probe analysis 2 wt % Sr-doped SnO_2 shows the highest value of the electrical conductivity (27.92 $\Omega.cm)^{-1}$ compared to the other samples.

References

10. N. Rahima, "Elaboration and characterisation of undoped and doped indium oxide thin layers elaborated by sol gel process for photonic and photovoltaic applications", University of Biskra- Algeria, 2022.

The Effect of Extracts Obtained from Viticulture Wastes on the Grapevines Maturity Degree

Ionela-D. Toma (Sărdărescu)[1,2*], Diana E. Vizitiu[2], Irina Fierăscu[3,4], Anda M. Baroi[3,4], Alin Din[2], Radu C. Fierăscu[1,3]

[1]Faculty of Chemical Engineering and Biotechnology, National University of Science and Technology Politehnica Bucharest, 1-7 Gh. Polizu Str., 011061 Bucharest, Romania

[2]National Research and Development Institute for Biotechnology in Horticulture, Stefanesti, 117715, Romania

[3] The National Institute for Research & Development in Chemistry and Petrochemistry, 060021, Bucharest, Romania

[4]Faculty of Horticulture, University of Agronomic Sciences and Veterinary Medicine of Bucharest, 011464 Bucharest, Romania

*Correspondence: ionela.toma93@yahoo.com

ABSTRACT

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

Bone Tissue Engineering Scaffolds Based on Pure and Zn Doped Merwinite Obtained by 3D Printing

Maria-Eliza Pușcașu [1], Florentina-Gabriela Ioniță [2,*], Cristina Busuioc[1]

[1] *Faculty of Chemical Engineering and Biotechnologies, National University of science and Technology POLITEHNICA Bucharest, 1-7 Gh. Polizu Street, 011061, Bucharest, Romania*

[2] *Faculty of Medical Engineering, National University of Science and Technology POLITEHNICA Bucharest, 1-7 Gh. Polizu Street, 011061, Bucharest, Romania*

*Correspondence: gabriela.ionita08@gmail.com

ABSTRACT

The current study involves the fabrication of mineral scaffolds based on merwinite, as well as a variant of this calcium magnesium silicate doped with zinc to enhance its antibacterial effect. The sol-gel approach was selected as processing method due to its well-known advantages in terms of homogeneity and dimensional control. The gels obtained from the synthesis were dried at 100 °C, ground, and subsequently calcined at 600 °C.

After calcination of the powders, they were mixed with hydroxypropylmethylcellulose (HPMC), resulting in pastes used in the 3D printing process, which allowed us to control the shape, size, and porosity of the scaffolds. By strictly controlling the printing parameters - pressure, speed, nozzle size, distance between extruded lines, several scaffolds were produced to optimize the entire manufacturing process. In the next step, the samples were thermally treated at 1200 or 1300 °C in order to remove the additive and promote the formation of a resistance structucture suitable for hard tissue engineering applications, also mimicking the spongy internal structure of bone. The micro-porosity provided by HPMC, as well as the macro-porosity achieved through additive manufacturing are favorable factors for the desired biological phenomena in bone regeneration, such as the adhesion and proliferation of osteoblasts at the implant site.

Through qualitative chemical analyses, FT-IR and EDAX, the chemical composition of the sintered porous structures was investigated. The results showed that the polymeric mass of HPMC was completely eliminated following the heat treatment. SEM images highlighted the porous morphology of the scaffolds, as well as the controlled size and shape achieved through the 3D printing technique.

References

[1]A.E. Alecu *et al.*, Synthesis and Characterization of Porous Forsterite Ceramics with Prospective Tissue Engineering Applications, Materials 15 (2022) 6942.

[2]C.I. Dobriţa *et al.*, Porous Bioceramic Scaffolds Based on Akermanite Obtained by 3D Printing for Bone Tissue Engineering, Ceramics International 49 (2023) 35898–35906.

[3]S.K. Venkatraman and S. Swamiappan, Review on Calcium- and Magnesium-Based Silicates for Bone Tissue Engineering Applications, Journal of Biomedical Materials Research A 108 (2020) 1546–1562.

Characterization and Synthesis of 45S5 Bioactive Glass via the Sol-Gel Method

Marian Rașcov[1,*], Anton Ficai[1,2,3], Ovidiu Cristian Oprea[1], Otilia-Ruxandra Vasile[1,2], Roxana Doina Trușcă[2], Ecaterina Andronescu[1,2,3]

[1]Department of Science and Engineering of Oxide Materials and Nanomaterials, Faculty of Chemical Engineering and Biotechnologies, *National University of science and Technology POLITEHNICA Bucharest*, Gh. Polizu 1-7, 011061, Bucharest, Romania

[2]National Centre for Micro and Nanomaterials, *National University of science and Technology POLITEHNICA Bucharest*, 060042, Bucharest, Romania

[3]Academy of Romanian Scientists, Ilfov Street 3, 050044 Bucharest, Romania

*Correspondence: marian.rascov@yahoo.com

ABSTRACT

Bioglass, also known as bioactive glass (BG), is a groundbreaking material in the field of biomaterials. Developed in the late 20th century, bioglass is renowned for its ability to bond with both hard and soft tissues in the human body, making it invaluable in medical applications such as bone regeneration and dental implants. Its porous structure facilitates the growth of new tissues while minimizing inflammation and toxicity.[1,2,3] Composed primarily of silicon, calcium, and phosphorus, bioglass dissolves gradually, releasing ions that stimulate cellular activity and promote healing. This unique combination of properties positions bioglass as a pivotal material in regenerative medicine and tissue engineering.

Sol-gel synthesised BGs have a greater specific surface area and are more porous.[4,5,6,7] Using lower processing temperatures than those required in the conventional glass melting or ceramic powder consolidation processes, the sol-gel process allows for the production of extremely homogenous and chemically pure materials.[8,9] Through sol-gel method could be obtained BGs with higher bioactivity, homogeneity and purity.[4]

This study presents the synthesis of the 45S5 bioglass (45 mol% SiO_2, 24.5 mol% CaO, 24.5 mol% Na_2O, 6 mol% P_2O_5) by sol-gel process.[10] This quaternary system was firstly reported by Hench.[1]

FTIR-ATR technique was used to obtain infrared spectra of 45S5 BG before and after soaking in simulated body fluid for 1, 3, 7, 14 and 28 days, providing insights into the molecular composition and structural characteristics.

Particle size, shape, morphology and elemental analysis were achieved by using scanning electron microscopy coupled with energy dispersive X-ray analysis (SEM/EDAX).

TG-DSC technique was involved to analyze the thermal properties of the synthesized bioglass particles. The main decomposition event takes place between 640-800ºC and is associated with an endothermic effect.

By providing insights for biomedical applications, this paper advances our understanding of how bioactive materials, such as bioglass particles respond to simulated physiological environments.

References

1. Hench, L. L., The story of Bioglass. *Journal of materials science. Materials in medicine*, 2006, 17(11), 967–978. https://doi.org/10.1007/s10856-006-0432-z
2. Hench, L. L., Jones. J. R., Bioactive Glasses: Frontiers and Challenges. *Frontiers in bioengineering and biotechnology*, 2015, 3, 194. https://doi.org/10.3389/fbioe.2015.00194
3. Vafa, E., Bazargan-Lari, R., Bahrololoom, M. E. Synthesis of 45S5 bioactive glass-ceramic using the sol-gel method, catalyzed by low concentration acetic acid extracted from homemade vinegar. *Journal of Materials Research and Technology*, 2021, 10, 1427-1436. https://doi.org/10.1016/j.jmrt.2020.12.093
4. Faure, J., Drevet, R., Lemelle, A., Ben Jaber, N., Tara, A., El Btaouri, H., Benhayoune, H., A new sol–gel synthesis of 45S5 bioactive glass using an organic acid as catalyst. *Materials Science and Engineering C*, 2015, 47, 407-412. https://doi.org/10.1016/j.msec.2014.11.045
5. Shanmugam, K., Sahadevan, R., 1 - Bioceramics—An introductory overview. *Fundamental Biomaterials: Ceramics*, 2018, 1-46. https://doi.org/10.1016/B978-0-08-102203-0.00001-9
6. Fiume, E., Migneco, C., Verné, E., Baino, F., Comparison between bioactive sol-gel and melt-derived glasses/glass-ceramics based on the multicomponent SiO_2–P_2O_5–CaO–MgO–Na_2O–K_2O system. *Materials*, 2020, 13(3), 540. https://doi.org/10.3390/ma13030540
7. Wajda, A., Sitarz, M., Structural and microstructural comparison of bioactive melt-derived and gel-derived glasses from CaO-SiO_2 binary system. *Ceramics International*, 2018, 44(8), 8856-8863. https://doi.org/10.1016/j.ceramint.2018.02.070
8. Baikousi, M., Agathopoulos, S., Panagiotopoulos, I., Georgoulis, A.D., Louloudi, M., Karakassides, M.A., Synthesis and characterization of sol–gel derived bioactive CaO–SiO_2–P_2O_5 glasses containing magnetic nanoparticles. Journal of Sol-Gel Science and Technology, 2008, 47, 95–101. https://doi.org/10.1007/s10971-008-1720-5
9. Jones, J.R., Review of bioactive glass: from Hench to hybrids. *Acta Biomaterialia*, 2013, 9(1) , 4457-4486. https://doi.org/10.1016/j.actbio.2012.08.023
10. Ur Rahman, M. S., Tahir, M. A., Noreen, S., Yasir, M., Ahmad, I., Khan, M. B., Ali, K. W., Shoaib, M., Bahadur, A., & Iqbal, S. Magnetic mesoporous bioactive glass for synergetic use in bone regeneration, hyperthermia treatment, and controlled drug delivery. RSC advances, 2020, 10(36), 21413–21419. https://doi.org/10.1039/c9ra09349d

Development of Nanocomposites based on Recycled High-Density Polyethylene and Organically Modified Montmorillonite

Maria Daniela Stelescu[1], **Ovidiu Cristian Oprea[2,3*]**, Doina Constantinescu[4], Maria Sonmez[1], Mihai Georgescu[1], Ludmila Motelica[2,3], Denisa Ficai[2,3], Dana Florentina Gurau[1]

[1] National Research & Development Institute for Textiles and Leather–Division: Leather and Footwear Research Institute, 031215, Bucharest, Romania

[2]Faculty of Chemical Engineering and Biotechnologies, National University of Science and Technology POLITEHNICA Bucharest, 011061 Bucharest, Romania

[3]Academy of Romanian Scientists, 3 Ilfov St., 050044, Bucharest, Romania

[4]S.C. Monofil S.R.L., 617410, Săvinești, Romania

*Correspondence: ovidiu73@yahoo.com

ABSTRACT

Plastic materials have shown a rapid development in the last decades due to their superior properties that have allowed their use in different fields such as: the packaging industry, construction, agriculture, medicine, the pharmaceutical industry, the food industry, the furniture industry. As the waste resulting from the end of the life cycle of plastic products is not biodegradable and can affect the environment, different strategies and directives have been adopted at national, European or worldwide level. The largest amount of plastic waste comes from post-consumer packaging. They are generally manufactured from the following types of polymers: polypropylene, low density polyethylene, high density polyethylene, polyethylene terephthalate. In general, this post-consumer waste contains a mixture of polymers, which, in addition to the fact that it complicates the mechanical recycling process, it leads to the obtaining of recycled plastic materials of lower quality, making mechanical recycling inefficient from an economic point of view [1]. Starting from these aspects, the aim of this work was to improve the properties of mechanically recycled high density polyethylene (rHDPE) from packaging waste, by adding a small amount of organically modified montmorillonite (OMMT), a compatibilizing agent and other ingredients. The literature [2] has shown that compared to their counterparts, polymer/OMMT nanocomposites generally present improved properties that may include: increased tear resistance, temperature resistance, improved resistance to water adsorption. The samples were made by the melt intercalation method using a Brabender Plasti-Corder mixer and then were modeled in the form of plates with standard dimensions on a laboratory-scale electrical press. They were analyzed from the point of view of physical-mechanical, chemical and thermal properties. The results are in accordance with those presented in the literature [2] and indicate an improvement of the analyzed properties.

Acknowledgments: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CCCDI - UEFISCDI, project number PN-III-P2-2.1-PED-2021-3177, 712PED/2022, within PNCDI III.

References

1. Constantinescu D., Boata B., Iordache M., Stelescu M. D., Georgescu M., Sönmez M., Technological Considerations Regarding The Mechanical Recycling Of Waste From Polyethylene And Polypropylene, Proceedings of the 9th International Conference on Advanced Materials and Systems, ICAMS 2022, Bucharest, Romania, 26-28 October, 2022, pp.401-406, https://doi.org/10.24264/icams-2022.IV.3
2. Guo Z, Xu R, Xue P, Study on Preparation of Ultra-High-Molecular-Weight Polyethylene Pipe of Good Thermal-Mechanical Properties Modified with Organo-Montmorillonite by Screw Extrusion. Materials. 2020; 13(15):3342. https://doi.org/10.3390/ma13153342

Biopolymer-Based Food Packaging: Techniques for Incorporating Functional Ingredients and Enhancing Food Quality

Pir Mohammad Junaid[1], Sadaf Zaidi[1*]

[1]Department of Post Harvest engineering and technology, Aligarh Muslim University, Aligarh, India, 202002. *Correspondence: sadaf.phet@gmail.com

ABSTRACT

Biopolymer-based food packaging materials exhibit variable properties depending on their source, structure, preparation technique, and degree of crosslinking. The method of incorporation affects the porosity, compactness, and surface rearrangement, requiring consideration of material compatibility and sensitivity to external factors. Efficient incorporation of functional ingredients into polysaccharide films can be achieved through solvent casting, extrusion, hydrocolloid gelation, electrospinning, encapsulation, and emulsion coating. Understanding the chemistry of the ingredients and polymers is crucial for selecting the appropriate method. Incorporating bioactive compounds within biopolymer packaging protects these substances, addresses their limitations, enhances their effectiveness, and enables novel food products. Solvent casting is a widely used, reliable, and versatile technique for producing biopolymer-based packaging films that enables the incorporation of functional ingredients. Electrospinning is used for fabricating polymer films and nanofibers, offering advantages like continuity, cost-effectiveness, and the ability to incorporate heat-sensitive ingredients. Food coatings provide an extra layer of protection and preservation, formulated with bioactive ingredients to enhance shelf life and quality. The coating act as barriers to external factors and help retain food properties, making them a cost-effective option for reducing post-harvest issues. This study examines the significance of leveraging various incorporation techniques to enable the use of diverse functional ingredients in food packaging applications.

References

1. Othman, S. H., Kahar, N. S., Nordin, N., & Ahmad Shapi'i, R. (2023). Properties and Food Packaging Applications of Solvent Casting-Made Starch-Based Films Incorporated with Essential Oils: A Review. Starch - Stärke, 75(5–6), 2200152. https://doi.org/10.1002/star.202200152
2. Junaid, P. M., Saikumar, A., Nazim, M. S., Zaidi, S., Badwaik, L. S., & Ahmad, F. (2024). Film-Based Packaging for Food Safety and Preservation: Issues and Perspectives. In *Microbial Biotechnology in the Food Industry: Advances, Challenges, and Potential Solutions* (pp. 429–446). Springer
3. Munteanu, B. S., & Vasile, C. (2021). Encapsulation of Natural Bioactive Compounds by Electrospinning—Applications in Food Storage and Safety. *Polymers*, *13*(21), 3771. https://doi.org/10.3390/polym13213771
4. Li, J., He, J., Huang, Y., Li, D., & Chen, X. (2015). Improving surface and mechanical properties of alginate films by using ethanol as a co-solvent during external gelation. *Carbohydrate Polymers*, *123*, 208–216. https://doi.org/10.1016/j.carbpol.2015.01.040
5. Khan, O. A., Zaidi, S., Islam, R. U., Naseem, S., & Junaid, P. M. (2023b). Enhanced shelf-life of peach fruit in alginate based edible coating loaded with TiO2 nanoparticles. *Progress in Organic Coatings*, *182*(May), 107688. https://doi.org/10.1016/j.porgcoat.2023.107688

NMR Study of Cinnamaldehyde Thiosemicarbazones Derivatives with Biological Potential

Roman Rusnac*, Andrei Ciursin, Aurelian Gulea

Moldova State University, Chisinau, Republic of Moldova

*Correspondence: roman.rusnac@usm.md.com

ABSTRACT

In recent years, a class of organic compounds called thiosemicrabazones has been studied more and more frequently. More and more research articles are published in which these substances appear as potential anticancer drugs, antibiotics and antioxidants. Thiosemicarbazones synthesized based on natural substances are promising, as they are potentially less toxic to humans, which increases their chances of practical application. This work describes the synthesis of two thiosemicarbazones of cinnamaldehyde (**1** and **2**. The structure of the obtained substances was confirmed by NMR spectroscopy.

To synthesize these substances, one equivalent of cinnamaldehyde was mixed with one equivalent of the corresponding thiosemicarbazide in ethanol solution (pH=3-4), 5-6 h, reflux.

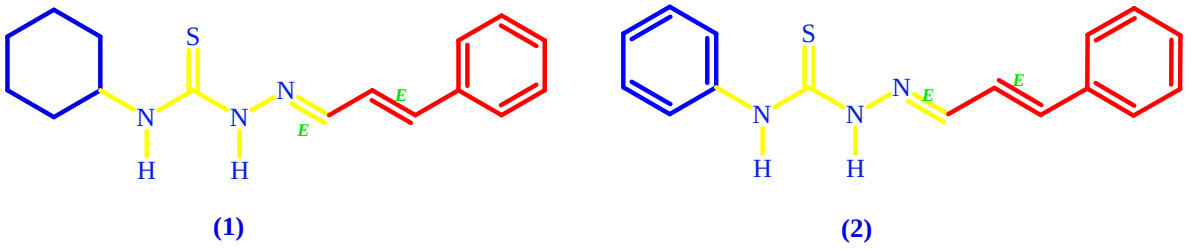


Figure 1. Structural formula of thiosemicarbazones (1) and (2)

Substance **1** – (2*E*)-N-cyclohexyl-2-[(2*E*)-3-phenylprop-2-en-1-ylidene]hydrazine-1-carbothioamide white crystalline solid [1].

Substance **2** – (2*E*)-N-phenyl-2-[(2*E*)-3-phenylprop-2-en-1-ylidene]hydrazine-1-carbothioamide white crystalline solid [2].

The antioxidant activity was also determined for the synthesized substances by ABTS cation radical inhibition method. The IC_{50} for thiosemicarbazone **1** was found to be – 30.04 ± 1.21 μM and for thiosemicarbazone **2** no significant antioxidant activity was found.

References

1. Sen, A.B.; Gupta,S.K. **Journal of the Indian Chemical Society**, **1962**, vol. 39, p. 628 – 634.
2. Current Patent Assignee: CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE - WO2006/16248, 2006, A1, Location in patent: Page/Page column 34-37.

Synthesis and Characterization of Polymeric Membranes Enhanced with Hydrothermally Activated Titanium Dioxide Nanoparticles

Simona Căprărescu[1,*], Roxana Gabriela Zgârian[1], Graţiela Teodora Tihan[1], Alexandru Mihai Grumezescu[1,2]

[1]National University of Science and Technology POLITEHNICA Bucharest, Faculty of Chemical Engineering and Biotechnologies, Ghe. Polizu Street, 011061, Bucharest, Romania

[2] Research Institute of the University of Bucharest—ICUB, University of Bucharest, 050657 Bucharest, Romania

* Corresponding author: simona.caprarescu@upb.ro

ABSTRACT

Throughout the years, numerous membranes containing nanoparticles (i.e., TiO_2, ZnO, Al_2O_3, SiO_2, Fe_2O_3, Ag) have been researched because the nanoparticles increase the hydrophilicity, permeability, chemical stability, and thermal resistance of the membrane [1-3].

This study presents the synthesis and characterization of the polymeric membranes containing natural and synthetical polymers, as well as hydrothermally activated titanium dioxide nanoparticles (NPs TiO_2). Polymeric membranes were produced using the phase inversion technique. To assess the physical, chemical, and functional characteristics of the polymeric membrane enhanced with hydrothermally activated NPs TiO_2, a similar polymeric membrane was synthesized without the activated NPs TiO_2. Both type of the obtained membranes were characterized by Fourier Transform Infrared Spectroscopy (FT-IR), and Scanning Electron Microscopy (SEM). The results confirmed that the hydrothermally activated NPs TiO_2 were successfully incorporated into the polymeric membrane matrix and indicated the interactions and interconnections between polymers, reagents, and the hydrothermally activated NPs TiO_2. The incorporation of the hydrothermally activated NPs TiO_2 into the polymeric membrane matrix affects the structure, permeability, chemical stability, and properties of the surfaces and pores of the formed membrane.

The results revealed that molecular-level interactions between polymer chains and hydrothermally activated NPs TiO_2 occurred, and demonstrated the effects of hydrothermally activated NPs TiO_2 on membrane morphology and on the properties of the polymeric membrane. The obtained polymeric membranes can be used in different applications, such as water separation, wastewater treatment, and seawater desalination.

References

1. S. Sarkar, S. Chakraborty, *Nanocomposite polymeric membrane a new trend of water and wastewater treatment: A short review*, Groundw. Sustain. Dev. 12 (2021) 100533.
2. M. Zahid, A. Rashid, S. Akram, Z. Rehan, W. Razzaq, *A comprehensive review on polymeric nano-composite membranes for water treatment*, J. Membr. Sci. Technol. 8 (2018) 1-20.

3. S. Caprarescu, C. Modrogan, V. Purcar, A.M. Dancila, O.D. Orbulet, *Study of polyvinyl alcohol-SiO2 nanoparticles polymeric membrane in wastewater treatment containing zinc ions*, Polymers 13 (2021) 1875.

Acknowledgment: "This work was supported by a grant from the National Program for Research of the National Association of Technical Universities - GNAC ARUT 2023, no. 155/04.12.2023".

Integration of Sol-Gel Synthesis and Additive Manufacturing Techniques for fabrication of walstromite-based scaffolds

Ștefania Chiriac (Caramarin)[1,2], Mihnea Pele[3], Georgeta Voicu[1*], Roxana Popescu[3,4], Andreia Cucuruz[3], Cristina-Daniela Ghițulică[1], Izabela-Cristina Stancu[1], Lucian-Toma Ciocan[5], Ruxandra-Elena Geanaliu-Nicolae[3]

1 Department of Science and Engineering of Oxide Materials and Nanomaterials, Faculty of Chemical Engineering and Biotechnologies, National University of Science and Technology Politehnica Bucharest, 1-7 Gh. Polizu Street, 011061, Bucharest, Romania

2 National R&D Institute for Non-Ferrous and Rare Metals, INCDMNR-IMNR, 102 Biruintei Blvd, 077145, Pantelimon, Romania

3 Department of Biomaterials and Medical Devices, Faculty of Medical Engineering, National University of Science and Technology Politehnica Bucharest, 1-7 Gh. Polizu Street, 011061, Bucharest, Romania

4 Department of Life and Environmental Physics, National Institute for R&D in Physics and Nuclear Engineering- Horia Hulubei, 30 Reactorului Street, 077125, Magurele, Romania

5 Department of Prosthetics Technology and Dental Materials, Carol Davila University

*Correspondence: **georgeta.voicu@upb.ro**

ABSTRACT

Recently, there has been considerable interest in exploring the role of barium in bone repair and regeneration, particularly within the realm of osteogenesis. Studies have shown that the addition of Ba^{2+} to bioceramic formulations enhances surface mineralization under in vitro conditions, as evidenced by immersion in simulated body fluid (SBF) [1]. Among these bioceramic materials, walstromite stands out as an oxide ceramic mineral phase containing silicon, calcium, and barium. Walstromite is characterized as a cyclosilicate mineral featuring Si_3O_9 rings composed of three silicon tetrahedra. While it has been previously recognized in the literature for its application in ceramics with electrical properties [2], its similarity to the wollastonite structure ($CaSiO_3$) is noteworthy, with minor structural changes arising from the substitution of Ca^{2+} with Ba^{2+} [3].

In light of this considerations, this study explores the potential of utilizing walstromite ($BaCa_2Si_3O_9$) as a foundational material for creating bioceramic scaffolds via 3D printing technology. The research investigates the chemical, mineralogical, morphological, and structural characteristics, as well as the biological properties of these scaffolds. The walstromite powder is obtained by sol-gel synthesis method and calcined at the optimum temperature determined by complex thermal analysis. Characterization of the calcined powder through X-ray diffraction and scanning electron microscopy reveals the presence of calcium and barium silicates, as well as monocalcium silicate. The calcined powder is then utilized in additive 3D printing to fabricate ceramic scaffolds. Various properties of the scaffolds, including density, absorption, porosity, and compressive strength, are evaluated to ensure it's practical use. X-ray diffraction analysis confirms the formation of walstromite as a single phase in the ceramic scaffolds. In vitro studies involving immersion in simulated body fluid (SBF) for 7 and 14 days, as well as interaction with osteoblast-like cells, demonstrate the scaffold's ability to form a phosphate layer

on its surface and its biocompatibility. Overall, the findings suggest that walstromite-based ceramic scaffolds exhibit promising characteristics for potential applications in bone regeneration and tissue engineering [4].

References

1. S. K. Arepalli, H. Tripathi, V. K. Vyas, S. Jain, S. K.Suman, R. Pyare and S. P. Singh, Materials Science and Engineering: C, 2015, 49, 549–559
2. W. Wisniewski, C. Thieme, R. Müller, S. Reinsch, S.-M. Groß-Barsnick and C. Rüssel, CrystEngComm, 2018, 20, 787–795.
3. S. K. Raut, N. S. Dhoble, K. Park and S. J. Dhoble, Mater Chem Phys, 2014, 147, 594–603
4. Chiriac, Ş.; Popescu, R.-C.; Pele, M.-M.; Ghiţulică, C.-D.; Cucuruz, A.; Geanaliu-Nicolae, R.-E.; Stancu, I.-C.; Voicu, G.; Ciocan, L.-T. *J. Funct. Biomater.* **2024**, *15*, 19.

Acknowledgements

This work was supported from the project Integrating mechanically-tunable 3D printing with new bioactive multi(nano)materials for next functional personalized bone regenerative scaffolds, PN-III-P4-PCE-2021-1240, no. PCE 88/2022

Preparation, Characterization and Mechanical Testing of PMMA/TiO_2 Film Nanocomposite

Yasmina Khane[1,2], Zoulikha Hafsi[1], Abdelhalim Zoukel[3].

[1] Faculty of Sciences and Technology, University of Ghardaïa, BP 455, 47000 Ghardaïa, Algeria.

[2] Materials, Energy Systems Technology and Environment Laboratory, Faculty of Sciences and Technology, University of Ghardaïa, BP 455, 47000 Ghardaïa, Algeria.

[3] Platform of Physico-Chemical Analysis (PTAPC-Laghouat-CRAPC), Laghouat, Algeria.

*Correspondence: yasminekhane@yahoo.fr

ABSTRACT

PMMA/TiO_2 film nanocomposites have garnered significant interest for their wide range of potential applications in fields such as biomedical engineering, food packaging, and environmental remediation. The nanocomposite thin films were formed by combining PMMA and TiO_2 nanoparticles through the casting method. Various techniques were employed to analyse the morphology, crystallinity, and thermal stability of the prepared films, including scanning electron microscopy, X-ray diffraction, and thermogravimetric analysis. The results indicated that the film nanocomposites of PMMA and TiO_2 exhibited a consistent structure and excellent resistance to heat. Extensive analysis was conducted on the mechanical properties of the nanocomposites through precise measurements of tensile strength and Young's modulus. Through careful experimentation, it was discovered that the incorporation of TiO_2 nanoparticles had a profound impact on enhancing the mechanical properties of the PMMA films. The nanocomposite films showed an increase in tensile strength and Young's modulus as the TiO_2 content was increased. Exploring the antibacterial activity of PMMA/TiO_2 film nanocomposites against both gramme negative bacteria *Escherichia coli* and gramme positive bacteria *Staphylococcus aureus* under visible light irradiation. These nanocomposites showed promising antibacterial activity, suggesting their potential use in creating food packaging materials with antibacterial properties.

Keywords – PMMA, TiO_2, casting method, film, mechanical properties, antibacterial activity.

Developing Chemically Modified Collagen Bone Graft Materials for Use in 3D Bioprinted Scaffolds

Zehra Betül Ahi[1], Mihriban Aydoğan-Gemici [1,2*], Beyza Çay[1]

[1]Kazlıçeşme R&D Center and Test Laboratory, 34956 Tuzla, Istanbul, Türkiye

[2]Gebze Technical University, Faculty of Science, The Department of Molecular Biology and Genetics, 41400 Gebze/Kocaeli, Türkiye

*Correspondence: zehraahi@kazlicesme.com.tr

ABSTRACT

Recently, autologous bone fragments or sponge/granular bone grafts are generally used to treat bone diseases. While autologous bone fragments repair the bone, damage occurs in the area where the autologous bone is received. Furthermore, sponge/granular bone grafts often cannot provide ideal implantation in a suitable geometry for damaged bones. Current 3D printing methods such as frame networks, usually synthetic polymers like PMMA (poly(methyl methacrylate)), PEEK (poly(ether ether ketone)) and UHMWPE (ultra-high molecular weight polyethylene) are used in patient-specific bone graft reproduction. Instead of using these materials in the treatment of bone matrix, efforts are being made to reconstruct and classify bone repair with hybrid properties and be more biocompatible. Advanced developments in 3D bioprinting technology worldwide enable bone grafts to be produced in a specially shaped anatomically shaped manner. At the same time, there is a need to produce biocompatible, biodegradable, and osteoconductive materials that produce personalized bone grafts [1].

Biomaterials prepared using collagen, a natural connective tissue component, are successfully used as a three-dimensional (3D) substrate for cell culture studies and are considered promising 3D scaffolds for creating artificial tissues. The most important factor in the development of such materials is the mimicking capability of the physical and morphological properties of the tissues that need to be repaired or replaced [2]. With this perspective in the presented study native bone collagen was used which was extracted from bovine bones. Afterwards, it was characterized by tests such as SDS-PAGE, FTIR, Western blot, DSC, TGA.

On the other hand, to obtain better simulation capacity, collagen was reinforced with native bone tissue minerals such as hydroxyapatite (HA), β-TCP, and bioactive glass minerals. Since collagen bioinks have low mechanical properties, making 3D printing studies difficult [2]. In the second step of this study, collagen-based bioinks were supported by adding hydroxyapatite (HA), β-TCP, and bioactive glass minerals to the bioink formulation in addition to collagen, in order to overcome this situation and to simulate the bone structure realistically. For this purpose, 3D printing studies were carried out by preparing bioink formulations using different ratios of collagen and minerals. At the end of this study, 3D bioprintable hybrid bone graft biomaterials were developed and characterized using collagen, which forms the main structure of the bone, and it was determined that they had a biocompatible structure by performing cell tests.

References

1. Roberts, T. T., & Rosenbaum, A. J. (2012). Bone grafts, bone substitutes and orthobiologics: the bridge between basic science and clinical advancements in fracture healing. Organogenesis, 8(4), 114-124
2. Osidak, E. O., Kozhukhov, V. I., Osidak, M. S., & Domogatsky, S. P. (2020). Collagen as bioink for bioprinting: A comprehensive review. International journal of bioprinting, 6(3)