Book of Abstracts

EUROINVENT
ICIR 2024

International Conference on Innovative Research

June 6th to 7th, 2024
Iasi – Romania

Organized by:

- **Romanian Inventors Forum**
- **Faculty of Materials Science and Engineering, The "Gheorghe Asachi" Technical University of Iasi, Romania**
- **ARHEOINVEST Platform, Alexandru Ioan Cuza University of Iasi**
- **Centre of Excellence Geopolymer and Green Technology CEGeoGTech), Universiti Malaysia Perlis (UniMAP)**
- **Department of Physics, Czestochowa University of Technology, Częstochowa, Poland**

With support of:

- **National Institute for Research and Development in Environmental Protection INCPDM**
- **International Federation of Inventors' Associations - IFIA**
- **World Invention Intellectual Property Associations – WIIPA**

Editors:

Andrei Victor SANDU, Mohd Mustafa Al Bakri ABDULLAH, Petrică VIZUREANU,

Marcin NABIALEK, Mohd Remy Rozainy Mohd Arif ZAINOL, Ion SANDU

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EUROPEAN EXHIBITION OF CREATIVITY AND INNOVATION

EUROINVENT

IAŞI – ROMANIA

XVIth Edition, 6th - 7th June 2024

Euroinvent is a Festival of innovation, a joint event promoting creativity in European context, by displaying the contributions of consecrated schools from higher education and academic research and also of individual inventors & researchers.

Under the auspices of EUROINVENT we organize:

1. **Inventions and Research Exhibition**

http://www.euroinvent.org/

2. **International Conference on Innovative Research**

http://www.euroinvent.org/conference

3. **Technical-Scientifical, Artistic and Literary Book Salon**

http://www.euroinvent.org/events-2/book-salon/

4. **European Visual Art Exhibition**

http://www.euroinvent.org/events-2/art-expo/

Event purposes:

- Dissemination of research results;
- partnerships and agreements;
- Creating and developing new research ideas;
- Technology transfer;
- Implementation of inventions,
- Scientific recognition.

The exhibition welcomes you to display inventions (patented in the last 7 years or have patent application number). A special section is held for innovative projects.

EUROINVENT International Conference on Innovative Research (ICIR) will bring together leading researchers, engineers and scientists will present actual research results in the field of Materials Science and Engineering.

euroinvent@yahoo.com

Foreword

This volume contains the information of the ICIR Euroinvent 2024 Conference and the abstracts of selected peer-reviewed papers.

The ICIR Conference is organized under the auspices of EUROINVENT. Euroinvent is a joint event promoting creativity in a European context, by displaying the contributions of consecrated schools from higher education and academic research and also of individual inventors and researchers.

The EUROINVENT International Conference on Innovative Research (ICIR) brings together leading researchers, engineers and scientists who will present actual research results in the field of Materials Science and Engineering.

The conference aims to provide a high level international forum for researchers, engineers and scientists to present their new advances and research results in the field of materials science and engineering.

The volume covers all the aspects of materials science, from synthesis and characterization of materials to procedures and technologies for materials engineering, as well as materials application and their involvement in the life sciences.

All the papers have been reviewed by minimum two expert referees in their relevant topic disciplines. The papers selected for the volume depended on their quality and relevancy to the conference.

The editors hope that this volume will provide the reader a broad overview of the latest advances in the field of materials science and engineering, and that they will be a valuable references source for further research.

The editors would like to express their sincere appreciations and thanks to all the committee members of the ICIR 2024 for their tremendous efforts. Thanks also to the publishers for supporting the publication of the full articles.

Finally, the editors would like to thank all the authors for their contribution to this valuable volume.

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Program of EUROINVENT ICIR Conference
ORAL PRESENTATION

*Palace of Culture Iasi – **Voievozilor Hall***

DAY 1 – THURSDAY JUNE 06	
9.00	Participants registration
11.00	**EUROINVENT Opening Ceremony**
12.00	**ICIR Opening Ceremony**
12.15	**Session 1** Chairman: Prof. Dr. Petrică VIZUREANU Prof. Dr. Mohd Mustafa Al Bakri ABDULLAH Prof. Dr. Ion SANDU
12.15	**Keynote Speaker – Carlos THOMAS** *Exploration in the Use of Recycled Aggregates and Concrete: New Opportunities*
12.45	**Keynote Speaker – António GASPAR-CUNHA** *Use of Artificial Intelligence Techniques in the Optimization of Polymer Manufacturing Processes*
13.15	***Snacks & Refreshments Break***
14.00	**Session 2** Chairman: Prof. Dr. Marcin NABIALEK Prof. Dr. Dimka FACHIKOVA Prof. Dr. Catalin POPA Prof. Dr. Iulian ANTONIAC
14.00	**Invited Speaker – Camilo ZAMORA-LEDEZMA** *Innovative Surface Treatments for Biomimetic Alumina Scaffolds in Bone Regeneration*
14.30	**Invited Speaker – Mohamad Anuar KAMARUDDIN** *Waste to Energy: A New Approach for Sustainable Waste Management*
15.00	**Laura HROSTEA** - *Influence of Acceptor Materials in Ternary Organic Thin Films Used In Photovoltaic Applications*
15.15	**Inga ZINICOVSCAIA** - *Effect of Gold and Silver Nanoparticles Functionalized by cyanobacteria Spirulina platensis on Rats*
15.30	**Norina FORNA** - *Innovative Materials in General and Oral Rehabilitation for Complex Complications of the Stomatognathic System Elements/Post-Malpractice*
15.45	**Adrian BOGORIN-PREDESCU, Stefan ȚÎȚU** - *Data acquisition system for a hydroelectric turbine located linearly on the course of flowing water*
16.00	**Mariusz WINIECKI** - *Titanium surface nano-structuring and activation with active radicals*
16.15	**Traian Florin MARINCA** - *Soft magnetic composite obtained from nanocrystalline Sendust alloy and Fe3O4 nanoparticles*
16.30	**Mihai Andrei PLATON** - *Behavior Characterization in Humid Environment of a Recycled Mixture ABS - PMMA - Glass Fibers Composite Material*
16.45	**Yulia IVASHKO** - *The destruction of the established urban environment of Borodianka and Irpen as a result of the Russian-Ukrainian war*
17.00	**Aurel Mihail TITU, Daniel BĂLC** - *The Analysis and the Optimization of an Autonomous Mobile Platform Equipped with a Manipulator Arm for Sample Retrieval in Rough Terrain*
17.15	**Zakaria OWUSU-YEBOAH** - Innovative Experimental Testing Program of Direct Shear Test in Soil Mechanics
17.30	**Aurel Mihail ȚÎȚU, Alexandra-Florina IAMANDII** - *Calculating the Carbon Footprint Within the Field of Road Freight Transport: A Specific Approach*
17.45	**Andreea-Maria MOLDOVEANU, Aurel Mihail ȚÎȚU** - *The Transition to Alternative Fuels in the Maritime Sector in the Context of Decarbonization. Opportunities and Constraints*
	Posters evaluation: 16:00 - 18:00
18.00	**End of Conference Day**

Program of EUROINVENT ICIR Conference
ORAL PRESENTATION

*Palace of Culture Iasi –**Voievozilor Hall***

DAY 2 – FRIDAY JUNE 07	
9.00	**Session 3** Chairman: Prof. Dr. Carlos THOMAS, Prof. Dr. Marius WINIECKI, Prof. Dr. Alexandru PASCU, Prof. Dr. Yulia IVASHKO
9.00	**Keynote Speaker – Julietta V. RAU** *Ion-Doping Strategy Applied to the Development of Antimicrobial Ceramic Materials for Biomedical Implants*
9.30	**Invited Speaker – Radu Claudiu FIERASCU** *Development of Apatitic Nanomaterials for Increasing the Quality of Life*
10.00	**Andreea Elena CONSTANTINESCU** - *Composite Materials with Printable and Antimicrobial Features for Biomedical Applications*
10.15	**Dimka FACHIKOVA** - *Applying of Calcium Phosphate Conversion Coatings for Biomedical Aims*
10.30	**Cătălin POPA** - *Novel Approach for Capillary Force Microfluidic Devices Designed for Medical Applications*
10.45	**Fathinul Syahir AHMAD SAAD** - *Fruit Quality Assessment in Agriculture: Firmness and Disease Assessment Based on High Level Features Fusion of Acoustic Impulse and Piezoelectric sensors*
11.00	**George Ciprian IATAN** - *Improvement of Corrosion and Wear Behaviour of Nab Marine Propeller Based on Superalloy Laser Cladding*
11.15	**Wan Mohd Arif W. IBRAHIM** - *Effect of Sintering Temperature on Structural, Physical and Mechanical Properties of The Activated-HAp Ceramic*
11.30	**Florin POPA** - *High Milling Time Influence on the Phase Stability and Electrical Properties of Fe50Mn35Sn15 Heusler Alloy Obtained by Mechanical Alloying*
11.45	**Isabela SADICA** - *Improving Wild Anadromous Sturgeon Conservation Status: Innovative By-Pass Solution for Iron Gates I to Reconnect the Historical Migration Routes.*
12.00	**Bianca TATARCAN -** *Assessment of atmospheric pressure plasma exposure on the seeds germination*
12.15	**Natalia ENACHE** - *Modelling the Influence of Soil and Meteorological Parameters on Carbon Dynamics for Conservation In Wetland Ecosystems*
12.30	**Piotr AUGUSTYN** - *High electric conductive polymer composites with electromagnetic field shielding properties*
12.45	**Victor TOSA** - *Electrospun Polymeric Fiber Systems Inoculated with Cyanoacrylate Tissue Adhesive: A Novel Hemostatic Alternative During Open Surgery*
13.00	**Tudor-Adrian COMAN** - *Demonstrator - Electro-Metallurgical Metalothermal Converter*
13.15	**Alexandru-Silviu GOGA** - *Integrating Artificial Intelligence in Nanomaterials Science: Pathways to Revolutionary Materials Discovery and Design. Ethics and Risks*
	Posters evaluation: 10:00 - 12:00
13.30	**Awards Ceremony and Conference Closure**
18.00	**Cocktail dinner - Restaurant – HOTEL CIRIC**

Program of EUROINVENT ICIR Conference
POSTER PRESENTATION

*Palace of Culture Iasi - **Voievozilor Hall***

DAY 1 – THURSDAY JUNE 06	
	Poster Session Chairman: Prof. Dr. Mohd Arif Anuar MOHD SALLEH Prof. Dr. Traian Florin MARINCA Prof. Dr. Mihail Aurel TITU
P1.	**Kalin KRUMOV** - Life Cycle Assessment of Geopolymers obtained from Bulgarian Industrial Wastes
P2.	**Gyorgy THALMAIER** - Corrosion properties of amorphous Ni40Ti40X20 (X=Nb, Zr) alloys in simulated PEMFC conditions
P3.	**Calin Virgiliu PRICA** - Cu-Al-Ni Nanocrystalline Compacts Obtained by Spark Plasma Sintering of Mechanically Alloyed Powders
P4.	**Aurel TABACARU** - Fabrication of very fine ZnS nanoparticles through surface organo-modification
P5.	**Bogdan Viorel NEAMTU** - Fibre-based Soft Magnetic Composites. A New Concept for Designing High-Performance Composite Magnetic Cores
P6.	**Andrei Constantin BERBECARU** - Research on the Impact Behaviour of Trip Steels
P7.	**George COMAN** - Corrosion behavior in aqueous environments of martensitic stainless steels used in hydropower turbine blades
P8.	**Lyudmila ANGELOVA** - Ecotoxicity assessment of geopolymerization process applied on mine mailing from Spain
P9.	**Cristian Stefan BUNDUC** - Polymer matrix composites: a short review
P10.	**Stefan Alexandru LAPTOIU** - Particularities Regarding the Deposition of Hydroxyapatite Through Electrical Impulse Discharges
P11.	**Edit Roxana MOLDOVAN** - Corrosion behaviour on Laser Surface Textured on AISI 430 ferritic stainless steel
P12.	**Nona SHIVACHEVA** - Phosphating of Carbon Steels in Zinc - Manganese Phosphate Concentrates
P13.	**Gergana ILIEVA** - Kinetics and Characterization of Phosphate Coatings Prepared on Aluminum Surfaces
P14.	**Emrah KARACAY** - Fe35Co20Ni20+xSi10Mo8-xCu7 (x=0, 3) Soft Magnetic High Entropy Alloys Obtained by Mechanical Alloying
P15.	**Dan Cristian CUCULEA** - Experimental research on laser cladding with pulsed laser and Ni-based powder
P16.	**Gyorgy DEAK** - Mitigating Transboundary Water Pollution Arising From Armed Conflicts: A Multidisciplinary Assessment Of The Black Sea And Coastal Area
P17.	**Kristina GARTSIYANOVA** - Potential Applications of Water-Energy-Food Nexus Concept through Preservation and Restoration of a Remarkable Site from Bulgarian Black Sea Coast
P18.	**Abdulhusein JAWDHARI** - Assessment of conservation status of Petroleuciscus borysthenicus celensis from Gurban River, Romania by Identification of Parasites and Bacteria
P19.	**Larisa POPESCU** - General Overview of BHR Prosthesis and Possible Causes of Their Failures
P20.	**Olga V. IVANOVA -** The Influence of Vibration Frequency on the Physical and Mechanical Properties of Pump Materials
P21.	**Sebastian GARUS** - Using Optimization Algorithms to Design Phononic Barriers Protecting Monuments or Building Facades
P22.	**Cristina Ileana COVALIU-MIERLA** - TiO2 Nanomaterial Application for Removal Detergent Pollutants in Wastewater Treatment Plant Technology
P23.	**Codrin-Dumitru CÎRLAN** - Analytical and Experimental Determination of the Modulus of Elasticity of the 75B Coating
P24.	**Edmond LEVARDĂ** - Copper Deposits Obtained by Arc Spraying Process - With Antibacterial and Corrosion Resistant Properties
P25.	**Steluța RADU** - Coating Properties of Smart Intermetallic Packaging Materials from Al2O3/ FeAl3 Obtained by Spraying with Atmospheric Plasma. Applications in the Food Engineering

Program of EUROINVENT ICIR Conference
POSTER PRESENTATION

*Palace of Culture Iasi - **Voievozilor Hall***

DAY 2 – FRIDAY JUNE 07	
	Poster Session Chairman: Prof. Dr. Mihail Aurel TITU Prof. Dr. Traian Florin MARINCA Prof. Dr. Mohd Arif Anuar MOHD SALLEH
P26.	**Shiru WANG** - Methods for the preservation and restoration of Dunhuang wall paintings: foreign experience
P27.	**Mohammed SULAYMAN -** Specific Issues of Conservation and Restoration of Libya Mosques (7th Century – 1815)
P28.	**Uliana SHCHEVIOVA** - Preserving authentic decoration in the entrance spaces of residential buildings in Eastern Galicia from the late 19th to the first third of the 20th century: restoration experience
P29.	**Valentyn GLYVA** - The innovative means of physical factors indoor normalization in reconstructed and restored buildings and structures
P30.	**Victoriia ZAITSEVA** - Aspects on preserving wall paintings (example of Ukraine and China)
P31.	**Nataliia KOVTIUKH -** Questions on the Object's Authenticity in Ukraine's Restoration Sector
P32.	**Oleksandr MOLODID** - Certain aspects of research work In the restoration of the Kyiv velodrome
P33.	**Ong Jing HONG** - Study on Water Quality at Sungai Batu Feringghi, Pulau Pinang by using Qual2K Modelling and GIS
P34.	**Mohammad Nasrun IBRAHIM** - Enhancing Biogas Purification Productivity Using Calcium Alginate Beads Embedded With Microbial Biomass
P35.	**Muhammad Syahmi Najmi Mat ADNAN** - Co-remediation of Refinery Oily Sludge with Food Waste Digestate
P36.	**Nur Bahijah MUSTAPA** - Microstructural and Strength Evolutions of Kaolin Geopolymer Based Ceramics at Different Sintering Temperature
P37.	**Georgeana CĂPĂŢÎNĂ** - Insights into New Materials for stab vests
P38.	**Bogdan Andrei ROTARU** - Advanced Materials for Telescopic Poles: A Multidisciplinary Approach
P39.	**Ion GHICULESCU** - A Comparative Study of Ti-Mo-Zr-Ta and Ti6Al4V Alloy
P40.	**Marius Albert MAZILU** - Titanium: The Metal Shaping Modern Medicine, Aerospace, and Automotive Industries
P41.	**Petrica VIZUREANU** - Advancing Biomedical Applications: Ti-Mo-Nb-Sn Alloys
P42.	**Madalina Simona BALTATU** - Investigating Lathe Tools in the Non-Metallic Materials Industry
P43.	**Ioana Corina MOGA** - Renewable Resources for Bricks' realization
P44.	**Mihai TOFAN** - Research Progress on the Complex Analysis of Top Cobalt and Titanium-Based Biomaterials
P45.	**Vasile Daniel GHERMAN** - A Green Biotechnology to Prevent Harmful Algae Blooms in Freshwater Lakes
P46.	**Manuela Cristina PERJU** - Influence of Temperature on Properties of the Carboxymethyl Cellulose Quenching Environment
P47.	**Dawid CEKUS** - Effect of Acoustic Waves Caused by Bells on a Stained-Glass Window
P48.	**Ionut LUCHIAN** - EDX Analysis of Three Composite Resins Used in Periodontal Splints
P49.	**Diana-Petronela BURDUHOS-NERGIS** - Corrosion Behaviour of Ca-Zn Phosphate Coating Deposited on Ti6Al4V
P50.	**Razan Al NAMAT** – Impact of COVID-19 Infection on Patients with Acute Myocardial Infarction Candidates for Coronary Artery Bypass Grafting
P51.	**Radu Claudiu FIERASCU -** Green Chemistry Nanomaterials for Increasing the Quality of Life

THE „GHEORGHE ASACHI" TECHNICAL UNIVERSITY OF IASI
Faculty of Materials Science and Engineering

The "Gheorghe Asachi" University of Iasi is an excellent choice for the highschool graduates, who wish to embrace a carrier in the attractive field of engineering. The eleven faculties of the university are well equipped and have renowned specialists.

The Faculty of Materials Science and Engineering at the "Gheorghe Asachi" Technical University of Iasi has the mission to train specialists for the materials engineering, mechanical engineering and industrial engineering fields, through a 4-year programme (B.Sc.), Master Courses and Ph.D. Programmes. Also, our faculty is involved in the scientific research programmes, as well as in life-long education programmes for professionals that wish to extend their expertise. Besides the formative activity, research in various fields, focused to multi-disciplinary national and international co-operation is highly valued.

Contact:
Blvd D. Mangeron 41A,
RO - 700050, Iaşi, România
Tel: +40.232. 230009
web: www.sim.tuiasi.ro

ROMANIAN INVENTORS FORUM

Romanian Inventors Forum (FIR), as a professional association of dialog and representation, has the purpose to support, stimulate, develop and valorize the scientifically, technically and artistically creativity. Under the aegis of FIR, Romanian Inventors have participated at more than 50 World Invention Exhibitions, where their creations have been awarded with orders, prizes and medals. The performance of Romanian inventics is renowned in the whole world, that is the reason why FIR became member in different international clubs, associations and federations, with special contributions.

Contact:
Str. Sf. P.Movila 3, L11, III/3
RO - 700089, Iaşi, România
Tel: +40.745.438604,
e-mail: euroinvent@yahoo.com
web: www.afir.org.ro

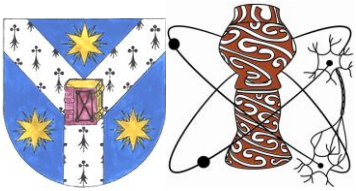
Universiti Malaysia Perlis (UniMAP) is Malaysia's 17th public institution of higher learning. It was approved by the Malaysian Cabinet on May 2001. Originally known as Kolej Universiti Kejuruteraa Utara Malaysia (KUKUM), or Northern Malaysia University College of Engineering, it was renamed as Universiti Malaysia Perlis (UniMAP) in February 2007. The first intake consisted of 116 engineering students who started classes on June 2002. Currently, UniMAP has approximately 14,000 students and a workforce of more than 2,100 academic and non-academic staff members. Universiti Malaysia Perlis (UniMAP) offers 14 programs of Bachelor in Engineering, 13 programs of Bachelor Engineering Technology, 6 programs of Bachelor Technology, 2 Bachelor in Business programs, 1 Bachelor in New Media Communication program and 6 Diploma level and over than 50 postgraduate programs that lead to the Master of Science in Engineering and PhD degrees.

Center of Excellence Geopolymer & Green Technology (CEGeoGTech) lead by Vice Chancellor Universiti Malaysia Perlis (UniMAP), Professor. Dr. Kamarudin Hussin. CEGeoGTech located at the School of Materials Engineering, Kompleks Pusat Pengajian Jejawi 2, Taman Muhibbah, 02600 Arau, Perlis. CEGeoGTech has been established on July 2011 with the intention to induce innovation in green material technology among researchers in Universiti Malaysia Perlis. CEGeoGTech are able combining their expertise and skills in various fields to support the academic structure in the generation of human capital that contributes to the development of high quality research. This center also can become a pillar of academic activities, especially regarding research, development and innovation. CEGeoGTech have 8 fields of research includes:

- ✓ Geopolymer
- ✓ Polymer Recycling
- ✓ Electronic Materials
- ✓ Ceramic
- ✓ Electrochemistry Materials & Metallurgy
- ✓ Environmental
- ✓ Manufacturing and Design
- ✓ Green ICT

Laboratory of Scientific Investigation and Cultural Heritage Conservation
ARHEOINVEST Platform, Alexandru Ioan Cuza University of Iasi

The Alexandru Ioan Cuza University of Iași is the oldest higher education institution in Romania. Since 1860, the university has been carrying on a tradition of excellence and innovation in the fields of education and research. With over 38.000 students and 800 academic staff, the university enjoys a high prestige at national and international level and cooperates with over 250 universities world-wide. The Alexandru Ioan Cuza University became the first student-centered university in Romania, once the Bologna Process was put into practice. Research at our university is top level. For the second year in a row, the University is placed first in the national research ranking. Striving for excellence, the university takes unique initiatives to stimulate research quality, to encourage dynamic and creative education and to attract the best students to academic life.



Contact:
Blvd. Carol I no. 11,
Corp G demisol
RO - 700506, Iaşi, România
e-mail: ion.sandu@uaic.ro
web: www.uaic.ro

Czestochowa University of Technology, Częstochowa, Poland
Department of Physics

Czestochowa University of Technology (CUT) is the largest state university in the region funded in the 40's last century. It is also the only one having full academic rights, i.e. it has the right to confer the title of doctor and university professor (habilitated doctor). During its scientific and educational activities, it has become an inherent part of Poland's history and tradition, of Czestochowa region and the city itself. In nationwide rankings of the state institutions of higher education, we are among the top universities in Poland of a similar profile.

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Częstochowska

CUT has a reputation for being a modern and well-equipped school which offers a wide range of courses and a high level of education. The excellent quality of our teaching and research and the unrivalled academic knowledge and experience of our academic staff make studying at CUT a stimulating and invaluable experience. The University also prides itself on having good student infrastructure, a wide range of high-standard laboratories and lecture rooms to support research and teaching as well as three halls of residence, its own publisher and a modern main library and faculty libraries.

All accepted papers, after the peer review, from EUROINVENT 2024 International Conference on Innovative Research will be published in:

Springer Proceedings in Materials
(Indexed by SCOPUS and sent for index in Web of Science)

Archives of Metallurgy and Materials (Indexed by Web of Science – ISI and Elsevier SCOPUS, **IF 0.586**)

Materials, Coatings, Micromachines, Applied Sciences, Magnetochemistry (MDPI Publisher – Indexed by Web of Science – ISI and Elsevier SCOPUS)

European Journal of Materials Science and Engineering (Indexed by DOAJ, Chemical Abstracts, CiteFactor)

International Journal of Conservation Science (Indexed by Web of Science – ISI and Elsevier SCOPUS)

Keynote Speaker

Julietta V. RAU, PhD

Professor
Institute of the Structure of Matter,
Italian National Research Council, Rome, Italy

Julietta V. Rau (Dr., PhD, Prof.) is currently Associated Research Director, Head of the laboratory and research group at the Italian National Research Council (CNR, Rome, Italy). She is the author of more than 200 publications in International Journals and about 180 presentations and 45 Invited, Plenary and Keynote talks at International Conferences. She received several International Awards for her research achievements. Her present H-index is 40 (i10-index is 125, Citations about 5000. She is the CHAIR and organizer of the biennial BioMaH "Biomaterials for Healthcare" International Conference (https://biomah.ism.cnr.it) and the Member of the International Scientific Committees of various International Conferences in the field of Materials Science, Nanoscience, Biomaterials and Medical devices. She is Ambassador for Italy at the European Orthopaedic Research Society. She is Associate Editor of the Bioactive Materials (KeAi)and In Vitro Models (Springer) Editorial Board Member of FRONTIES in Bioengineering and Biotechnology, FRONTIES in Biomaterials Science, Scientific Reports, Coatings MDPI, Journal of Advanced Drug Delivery Research, Drug Design Development & Therapy, EC Orthopaedics, The Open Biomedical Engineering Journal.

ION-DOPING STRATEGY APPLIED TO THE DEVELOPMENT OF ANTIMICROBIAL CERAMIC MATERIALS FOR BIOMEDICAL IMPLANTS

The essential requirements for implants include effective osteointegration, stability, and the capacity for bone regeneration. To fulfil these criteria, metallic implants are being enhanced with biomimetic functional ceramics, augmenting their properties and promoting integration with bone tissue. Critical aspect of implant development is imparting them with antimicrobial characteristics, crucial for minimizing the need for additional surgeries. Specifically, ion-substituted calcium phosphate bioceramics exhibit a wide range of functional properties, including antibacterial ones. The developed nanostructured antimicrobial materials hold promise for tissue replacement and regeneration strategies. They ensure the necessary structural, chemical, morphological, and mechanical properties, enable controlled release of active agents, and improve the long-term stability and performance of dental and orthopaedic implants.

Keynote Speaker

Carlos THOMAS, PhD

Professor
Universidad de Cantabria
Spain

Carlos Thomas, Ph.D. from the University of Cantabria, is a Professor at the Materials Department of the Civil Eng. School, focusing on the valorization of construction waste for recycled mortars and concrete. Over the past five years, he actively contributed to 20 R+D+i projects, leading 10, including three government-funded projects surpassing €500,000. These initiatives targeted steel slag valorization and the development of efficient concrete with recycled aggregates and steel fibers. With a track record of over 75 papers in indexed JCR international journals, Carlos is the lead author of the highly cited "Durability of recycled concrete." His work garnered recognition in the 2021 Highly Cited Papers in Web of Science. In 2013, he received the Best Paper award from the Road Materials and Pavement Design journal. Carlos successfully supervised 8 cum laude doctoral theses, and his mentees have excelled in academia and industry. As the Editor-in-Chief of the Journal of Building Engineering (Q1, ELSEVIER), Carlos conducted research internships at international institutions. He gained industry experience through internships at Bosch-Siemens, Mercedes-Benz, and DaimlerChrysler in Germany, supported by the Leonardo Scholarship grant.

EXPLORATION IN THE USE OF RECYCLED AGGREGATES AND CONCRETE: NEW OPPORTUNITIES

The conference focuses on the utilization of recycled concrete made with recycled aggregates, from different sources, introducing sustainable practices for environmental conservation. An essential aspect are the construction and demolition wastes, the electric arc furnace slag and fine industrial wastes to produce recycled aggregates, studying their mechanical and durability properties in concrete. The research delves into the integration of industrial enamel dust waste into mortars and concrete, emphasizing the environmental and technical benefits of this by-product. The utilization of high-density siderurgical aggregate in concrete for ionizing radiation protection is another key topic, offering insights into its efficacy for applications requiring radiological protection. The conference also showcases diverse applications of recycled concrete, including artificial reefs, railway sleepers, track bed systems, precast elements for road infrastructure, foundations, and port dikes. By providing a concise overview of these experiences, the conference aims to contribute valuable insights to sustainable construction, fostering a deeper understanding of the practical applications and benefits of recycled aggregates and concrete in diverse construction contexts.

Keynote Speaker

António GASPAR-CUNHA, PhD

Assistant Professor Habil.
Department of Polymer Engineering,
School of Engineering,
University of Minho, Portugal

Antonio Gaspar-Cunha received a PhD degree in Optimization and Modelling of Single Screw Extrusion from the University of Minho, Portugal, in 2000, and the habilitation in 2014 at the same University. He is currently an Assistant Professor with Habilitation of Polymer Processing at the University of Minho. The main areas of scientific activity are the modelling of polymer extrusion-based processes and multi-objective optimisation using artificial intelligence techniques. He is the author or co-author of more than 190 works, including books edited, book chapters, papers published in international refereed journals, and more published in proceedings of international conferences. In 2015 was the general chair of the 8th International Conference on Evolutionary Multi-Criterion Optimization (EMO2015) and in 2019 was the general chair of the EUROGEN 2019 international conference, both held in Guimarães, Portugal.

USE OF ARTIFICIAL INTELLIGENCE TECHNIQUES IN THE OPTIMIZATION OF POLYMER MANUFACTURING PROCESSES

Polymeric materials are transformed into final products using different processing techniques that depend mainly on the type of polymer used and on the product to be produced. These techniques include, only to nominate the most important, extrusion, injection moulding, blow moulding and thermoforming. The raw material, usually in solid granular form, needs to be initially melted to be possible to acquire the desired shape and, in the end, must be cooled to the form to be maintained. Given the special properties of the polymers, namely their low thermal conductivity and rheological behaviour, these tasks are not easy to accomplish. As a consequence, the geometry of the machines to be used and the operating conditions must be carefully defined. This work aims to present results concerning the use of numerical modelling software coupled with artificial intelligence and optimization algorithms to optimize the referred processes, i.e., design the machines and define the best operating conditions to use. For that, multiobjective optimization algorithms are coupled with artificial neural networks and data mining techniques are applied. Some results, showing the importance of the proposed methodology, are presented and discussed.

Invited Speaker

Camilo ZAMORA-LEDEZMA, PhD

Professor
Universidad Católica de Murcia, Spain

He is an experimental physicist. He obtained his PhD in the framework of a cotutelle with the Université de Montpellier (France) and the Universidad Central de Venezuela (Venezuela). He have been doing teaching and research at the Universidad Central de Venezuela, at the Instituto Venezolano de Investigaciones Científicas, at Polytech in Montpellier (France), at Université de Bordeaux (France) and at Yachay Tech University (Ecuador). Since 2018, he has been an invited researcher at the research group "Propiedades Mecánicas, Procesado y Modelización de Cerámicas Avanzadas" of the Universidad de Sevilla (Spain). Since 2021, he joined the Faculty of Pharmacy and Nutrition of the Universidad Católica de Murcia (Spain), as full-time Researcher/Teaching and Research Staff (PDI) in the research group "Green and Innovative Technologies for Food, Environment and Bioengineering". His research activities are mainly focused on the synthesis of tailored organic/inorganic nanomaterials and biomaterials based on nanocarbon and nanoparticles. He also has broad experiences in experimental techniques of characterizations of materials such as Raman, UV-vis, FTIR, and XPS spectroscopies, electron microscopies as well as characterization of the mechanical properties and the nano/microstructure of materials. He directed various undergraduate and doctoral thesis and co-authored more than forty-five (45) articles and book chapters related to materials science, nanomaterials, and biomaterials. Finally, he has been a principal investigator and collaborator researcher in more than 12 national, European and international competitive projects.

INNOVATIVE SURFACE TREATMENTS FOR BIOMIMETIC ALUMINA SCAFFOLDS IN BONE REGENERATION

In the intricate domain of biomaterials, ceramics emerge as promising long last alternatives in clinical applications, unyielding, yet remarkably adaptable. Among these, alumina ceramics stand as profound potential. Composed primarily of aluminum oxide, these ceramics have captivated the imaginations of researchers and clinicians alike. In this talk, we will present recent research that introduces a novel procedure for the bioactivation of alumina-based porous ceramic constructs, specifically designed to mimic the structural and mechanical properties of human cortical bone [1]. By incorporating wollastonite and applying an acidic surface treatment (piranha solution), we achieved constructs with adequate pore size and interconnectivity. Uniaxial compression tests revealed that as the wollastonite content increased, the Young's moduli and compressive strength decreased. Importantly, our study demonstrated that increasing wollastonite content significantly enhanced the proliferation rates of bone-marrow-derived mesenchymal stem cells, without any observed cytotoxic effects. These findings position our bioactivated alumina-based porous ceramics as promising materials for practical bone tissue engineering applications..

Invited Speaker

Radu Claudiu FIERĂSCU, PhD

Senior Researcher
National Institute for Research & Development in Chemistry and Petrochemistry – ICECHIM Bucharest
Romania

Alumni of the University of Bucharest, Dr. Fierăscu has been active since 2006 within ICECHIM Bucharest. He is currently senior researcher and Technical Director of ICECHIM. Since 2023 he serves as President of the Scientific Council of ICECHIM for a four years mandate. Since 2019 he is also PhD supervisor within the National University of Science and Technology Politehnica Bucharest, Chemical Engineering field. He led, as project manager/partner responsible several RDI projects, with a total value over 10 million euros, being main author/co-author of more than 170 ISI papers (H-index– 26), having more than 2100 citations, author/co-author of more than 20 books/book chapters and over 30 granted patents & patent applications. His scientific research activity was carried out in the development of new materials and technologies with applications in increasing the quality of life (including environmental protection, preservation of cultural heritage and biomedical applications). At national level, he developed the field of phytosynthesis of metallic nanoparticles, establishing in 2018 in ICECHIM the research group Emerging Nanotechnologies.

DEVELOPMENT OF APATITIC NANOMATERIALS FOR INCREASING THE QUALITY OF LIFE

The research focuses on the development of new apatitic nanomaterials with practical application in increasing the quality of life. For more than a decade, our group proposed, in different research projects, the application of tuned-properties apatitic materials in different areas, intended for increasing the quality of life. As such, different types of materials and composites were developed and their potential use in the protection of cultural heritage artifacts, in the development of antimicrobial composites or in environmental protection (particularly for water treatment) was evaluated. In time, the technology readiness levels of the proposed solutions was increased, reaching pilot-scale demonstrators, or even real-life application. All the obtained results demonstrate the tremendous potential of this type of materials to be used in daily applications, as well as their versatility for different types of applicaiton.

Invited Speaker

Mohamad Anuar KAMARUDDIN, PhD

Associate Professor
Environmental Technology Division,
School of Industrial Technology, Universiti Sains Malaysia

Dr. Anuar, is lecturer at the School of Industrial Technology, Universiti Sains Malaysia, boasts extensive experience in research and environmental consultancy within diverse sectors, including industries, institutions, and government agencies. Specializing in scheduled waste management and solid waste management, he has provided his expertise to a wide range of organizations. Dr. Anuar's proficiency is acknowledged in environmental management compliance, encompassing environmental audit, monitoring, impact assessment, management, and due diligence. He has actively participated in technical seminars and academic conferences, presenting his research findings. With over 40 peer-reviewed journal publications at the international level, Dr. Anuar is currently engaged as a subject matter expert in municipal solid waste management treatment, waste-to-wealth technologies, and waste diversion initiatives.

WASTE TO ENERGY: A NEW APPROACH FOR SUSTAINABLE WASTE MANAGEMENT

The exponential increase in greenhouse gas emissions associated with municipal solid waste (MSW) disposal in recent decades is primarily attributed to the heavy reliance on conventional landfilling methods. This trend correlates closely with ever increasing population growth and shifts in human lifestyles. Conventional landfilling requires significant land area for landfill cells, leading to the release of untreated leachate into nearby water bodies and unsustainable emissions of landfill gases. Therefore, transitioning to cleaner, more efficient, and environmentally sustainable waste treatment technologies is advisable. Currently, gasification, incineration, pyrolysis, and anaerobic digestion are the most prominent waste treatment methods globally. However, their effectiveness varies depending on the waste composition and quality, making it challenging for end-users to fully grasp their efficacy. To address this issue, it is crucial to establish high-tech waste-to-energy facilities that can meet specific waste compositions of the local area. However, identifying revenue streams for these technologies is challenging for the return of investment and the need to comply with strict local regulations, resulting in increased operational costs. Thus, stakeholders must carefully evaluate the optimal waste treatment approach. In tropical climates, a significant portion of MSW comprises organic matter, primarily from food waste, accounting for up to 45% of total waste components. Additionally, it is estimated that over 25% of recyclable materials are improperly disposed of in landfills, reducing their intended lifespan. Therefore, employing advanced technology for the pre-treatment of both organic and inorganic MSW components is recommended.

SECTION 1

SYNTHESIS AND CHARACTERIZATION OF MATERIALS

Green Chemistry Nanomaterials for Increasing the Quality of Life

Irina FIERASCU[1,2], Radu Claudiu FIERASCU[1,3*], Daniela TOMA (SĂRDĂRESCU)[3,4], Anda Maria BAROI[1,2], Roxana Ioana MATEI (BRAZDIS)[1,3], Toma FISTOS[1,3], Irina Elena CHICAN[1], Ioana Silvia HOSU[1], Lia Mara DITU[1, 5]

[1] The National Institute for Research & Development in Chemistry and Petrochemistry – ICECHIM Bucharest, 202 Splaiul Independentei, 060021, Bucharest, Romania
[2] Faculty of Horticulture, University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Boulevard, 011464 Bucharest, Romania
[3] Faculty of Chemical Engineering and Biotechnology, National University of Science and Technology Politehnica Bucharest, 1-7 Gheorghe Polizu St., 011061, Romania
[4] National Research and Development Institute for Biotechnology in Horticulture, 37 București – Pitești Str., Stefanesti, Argeș, 117715, Romania
[5] Faculty of Biology, University of Bucharest, 91 Splaiul Independenței, Bucharest, 050104, Romania

[*]fierascu.radu@icechim.ro

Abstract. Over the laste decades, nanotechnology led to great imporvements on the quality of life, nanomaterials finding applications in many day-by-day applications. However, with the progress in this field, questions related to the toxicity and potential hazards of these nanomaterials were raised. As a promising alternative, the development of nanomaterials following the principles of “green chemistry” gained importance, answering several of the issues related to the application of nanomaterials. The present work intends to present the results obtained by our group in the development of “green” nanomaterials and their use in practical application, including, but not limited to, dental materials, crop protection and biostimulants.

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Effect of Gold and Silver Nanoparticles Functionalized by Cyanobacteria *Spirulina platensis* on Rats

Inga ZINICOVSCAIA[1,2*], Ludmila RUDI[3], Liliana CEPOI[3], Tatiana CHIRIAC[3], Nikita YUSHIN[2], Anastasia CEPOI[3], Dmitrii GROZDOV[2]

[1]Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, 30 Reactorului Str. MG-6, Magurele, Romania
[2]Joint Institute for Nuclear Research, 6 Joliot-Curie Str., 141980 Dubna
[3]Institute of Microbiology and Biotechnology, Technical University of Moldova, Chisinau, Moldova

[*]zinikovskaia@mail.ru

Abstract. The functionalization of gold and silver nanoparticles with living cells of *Spirulina platensis* (spirulina) was achieved through adding them to the cyanobacteria nutrient medium and performing a complete cycle of biomass growth. Biomass containing gold or silver nanoparticles in the amount of 1 µg/day versus unmodified nanoparticles stabilized in PEG, was administered to rats for 28 days, followed by a clearance period of the same duration. The accumulation of nanoparticles in different organs, the change in hematological, biochemical and morphometric parameters in the experimental animals were assessed at the end of the nanoparticle administration and the clearance periods. It was established that the level of functionalized and unmodified nanoparticles accumulation in the organs of rats was different. The highest content of gold and silver after the 28-day administration period was determined in kidneys, while of silver in brain and testicles. After the clearance period, the highest content of gold was detected in the liver and of silver in brain. Both types of nanoparticles induced changes in the leucogram of experimental animals. More pronounced changes being characteristic for unmodified gold nanoparticles. The gold nanoparticles tested in the present study are characterized by pronounced tropism towards ovaries. They can cause long-term or delayed effects, which include the increase in glucose and urea levels as well as the increase in ALT activity after the clearance period. The hematological indices of the rats did not change significantly under the action of the silver nanoparticles except for the content of reticulocytes and eosinophils, which increased significantly. Changes in the biochemical parameters did not exceed the limits of normal values.

Keywords: *Spirulina platensis;* silver nanoparticles; hematological indices

Behavior Characterization in Humid Environment of a Recycled Mixture ABS - PMMA - Glass Fibers Composite Material

Mihai Andrei PLATON[1], Ovidiu NEMES[1*]

[1]Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, Romania

*ovidiu.nemes@imadd.utcluj.ro

Abstract. This article presents the challenges encountered in the recycling of mixed polymeric waste where the glass fiber constituent becomes the reinforcement of a non-oriented short fiber composite material. Recycling methods are varied for this type of waste: pyrolysis, solvolysis, mechanical recycling, as an additive, or as a fuel for cement production [1]. The method used to produce the experimental samples was thermoforming. As the used constituents were two thermoplastic polymers - ABS (Acrylonitrile butadiene styrene) and PMMA (Poly (methyl methacrylate), thermoforming was chosen as the method of waste processing. To characterize the new material behavior in wet environment and aging simulation we used a climatic chamber, and more mechanical tests were performed. The experimental plan was designed according to the potential areas of use: external soundproofing panels or elements of building structures. The thermoforming method has advantages not only in terms of reduced energy consumption but also in terms of the versatility of the products that can be thermoformed and the wide range of uses of the ecological products obtained. Further, depending on the results, more internal and external surface analysis will be performed to describe matrix - reinforcement interactions.

Keywords: polymers, recycling, sustainability, mixed waste

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Corrosion Properties of Amorphous $Ni_{40}Ti_{40}X_{20}$ (X=Nb, Zr) Alloys in Simulated PEMFC Conditions

Gyorgy THALMAIER[1], Mihail CHIRA[1], Niculina SECHEL[1], Horia VERMESAN[1], Ioan VIDA–SIMITI[1,2]

[1] Technical University of Cluj-Napoca 103-105 Muncii Ave., 400641, Cluj-Napoca, Romania
[2]Technical Science Academy of Romania, 26. Dacia Ave., 010413, Bucharest Romania.

*gyorgy.thalmaier@sim.utcluj.ro

Abstract. In this paper we are investigating the behavior of two nickel based amorphous alloys Ni40Ti40Nb20 and Ni40Ti40Zr20 in conditions that simulate the environment encountered by the bipolar plates in fuel cells. The major requirements of the metallic bipolar plate material are low weight, high corrosion and low contact resistance. The contact resistances measured on this amorphous alloy were found to be comparable with that of the uncoated 316L stainless steel. Their surface energy is high, evidenced by the water contact angle close to 90 °. The corrosion resistance of these alloys was studied in an 1 N H_2SO_4 electrolyte at 70 °C bubbled with hydrogen and air in order to simulate the anodic and cathodic PEMFC environment. The corrosion measurements suggest a better corrosion behavior of the Ni40Ti40Nb20 alloy than the Ni40Ti40Zr20 alloy due to the formation of a thinner but more stable passive layer.

Keywords: amorphous alloys, polymer electrolyte membrane fuel cells, corrosion.

Soft Magnetic Composite Obtained from Nanocrystalline Sendust Alloy and Fe_3O_4 Nanoparticles

Traian Florin MARINCA[1*], Bogdan Viorel NEAMȚU[1], Florin POPA[1], Virgiliu Călin PRICĂ[1], Ionel CHICINAȘ[1],

[1] Materials Science and Engineering Department, Technical University of Cluj-Napoca, 103-105 Muncii Avenue, 400641, Cluj-Napoca, Romania

[*]traian.marinca@stm.utcluj.ro

Abstract. Soft magnetic composites (SMC) have been prepared starting from Sendust nanocrystalline powder (Fe85Si9Al6). The Sendust type powder have been prepared in nanocrystalline state using elemental powder by mechanical alloying (milling time was up to 15 h). The mean crystallite size of Sendust is about 20 nm and the particles size from 1 to 50 μm. A subsequent heat treatment was applied to the mechanically alloyed powder in order to reduce the stresses (argon atmosphere, 600 ºC for 2 h). The as milled and heat-treated powder have been that mixed with an amount of 3% of iron oxide – Fe_3O_4 nanoparticles (50-100 nm) to obtain SMCs. The nanoparticles have been first dispersed in acetone and further mixed with the nanocrystalline alloy. The compaction of the mixed powder has been done by pressing (700 MPa) with a small amount of resin (2% wt.). Toroidal shaped SMC have been prepared. The role of the nanoparticles is to improve the density, electric and magnetic characteristics, to reduce the amount of nonmagnetic material. Several types of compacts have been produced and a comparison between the compacts was done. The compacts have been characterized from structural, microstructural, electric, and magnetic (magnetic characteristics in AC and DC) point of views. The influence of annealing and nanoparticles on the compacts properties was investigated.

Keywords: SMC, sendust, mechanosynthesis, nanocrystalline, magnetite.

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Cu-Al-Ni Nanocrystalline Compacts Obtained by Spark Plasma Sintering of Mechanically Alloyed Powders

Calin Virgiliu PRICA[1], Traian Florin MARINCA[1,] Florin POPA[1], Argentina Niculina SECHEL[1], Bogdan Viorel NEAMȚU[1], Ionel CHICINAȘ[1]

[1] Department of Materials Science, Technical University of Cluj-Napoca,Muncii Ave. 103-105, Romania

*calin.prica@stm.utcluj.ro

Abstract. The obtaining of Cu-Al-Ni shape memory alloys with nanocrystalline structure by mechanical alloying and spark plasma sintering, starting from a mixture of elemental powders, was investigated. After 16 hours of milling, a biphasic mixture formed of a copper-based solid solution and AlNi intermetallic compound distributed at the solid solution grain boundary resulted. The crystallite sizes of 16 hours milled Cu base solid solution is about 25 nm. After spark plasma sintering at 600 ^{o}C, the crystallite sizes increases to 35.7 nm and reaches 30 nm when the sintering temperature is 800 ^{o}C. With the sintering temperature increasing, the formation of the AlNi intermetallic compound was completed. The relative density of the compacts is in the range of 51.7% (600 ^{o}C) and 85% (900 ^{o}C) being dependent on the parameters of the sintering process (temperature, time), but also on the size of the particles of milled powder.

Keywords: mechanica alloying, nanocrystalline sturcture, spark plasma sintering.

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Innovative Materials in General and Oral Rehabilitation for Complex Complications of the Stomatognathic System Elements/ Post-Malpractice

Norina FORNA[1], Doriana AGOP-FORNA[1*], Lorenza DONEA[2], Norin FORNA[2]

[1] Discipline of Removable Prosthetics and Implantology, Faculty of Dental Medicine, U.M.F. "Grigore T.Popa" Iasi, 16 University Street, Romania
[2] Department of Dento-Alveolar and OMF Surgery, Faculty of Dental Medicine, U.M.F. "Grigore T.Popa" Iasi, 16 University Street, Romania
[3] Faculty of Medicine, U.M.F. "Grigore T.Popa" Iasi, 16 University Street, Romania; Clinical Gastroenterology Department, Emergency Clinical Hospital "Sf. Spiridon", Iasi, Romania
[4] Discipline of Orthopedic-Traumatology, Faculty of Medicine, U.M.F. "Grigore T.Popa" Iasi, 16 University Street, Romania

[*]dr.doriana.forna@gmail.com

Abstract. Full mouth reconstruction for edentulous patients offers a range of possibilities to restore oral function, aesthetics, and overall quality of life. The modern techniques available in the field of full mouth reconstruction are as follows: removable dentures, complete dentures, implant-supported overdentures, implant-retained overdentures (increased stability, retention, and chewing efficiency compared to conventional dentures), All-on-4 or All-on-X, implant-supported fixed bridges, hybrid prostheses. For patients with severe bone resorption, lost bone volume must be rehabilitated by alveolar ridge augmentation techniques using various categories of bone grafting materials. These procedures can be followed by post-operative complications, many of them related to iatrogenia or malpractice. Rehabilitation of the affected alveolar bone areas can be performed by injectable biomaterials due to low morbidity and possibility to be used in minimally invasive techniques.

Keywords: complications, rehabilitation, alveolar bone, bone grafts, PRF.

High Electric Conductive Polymer Composites with Electromagnetic Field Shielding Properties

Piotr AUGUSTYN[1*], Piotr RYTLEWSKI[1],

[1]Materials Engineering Faculty, Kazimierz Wielki University, 85-064 Bydgoszcz, Poland, Chodkiewicza 30 Street.

*augustyn@ukw.edu.pl

Abstract. This study presents the results of shielding effectiveness tests on acrylonitrile-butadiene-styrene terpolymer (ABS) matrix composites with carbon (conductive carbon black, carbon nanotubes, graphene flakes, carbon nanofibres) and metallic (tin powder, copper powder, copper-zinc alloy powder, copper fibres) fillers. For the first time, a comparative analysis was carried out for different fillers in order to assess their actual screening efficiency. Composites containing between 10 and 30% vol. of conductive fillers were examined. They were produced by manually mixing blended ABS in individual fillers on a vibrating plate. The prepared mixture was then compressed in a vulcanisation press at 200°C. An analysis of the most important material parameters and their influence on electromagnetic (EM) field shielding was carried out. Percolation thresholds were determined based on surface resistivity studies. The formation of continuous conductive structures in the surface layer of samples doped with metallic fillers was demonstrated. The highest values of shielding effectiveness were obtained for the composite containing copper fibres and tin powder. These values exceeded 60 dB of electromagnetic field attenuation for a filling degree of 30% vol. of the composite.

Keywords: polymer composites, conductive composites, conductive fillers, electromagnetic field shielding, percolation threshold.

Composite Materials with Printable and Antimicrobial Features for Biomedical Applications

Andreea Elena CONSTANTINESCU[1], Aura MOCANU[1,*], Florin MICULESCU[1], Ștefan Ioan VOICU[2,3], Madalina Andreea PANDELE[2,3], S. DONDEA[1], Stefan Alexandru LĂPTOIU[1]

[1] National University of Science and Technology POLITEHNICA Bucharest, Department of Metallic Materials Science, Physical Metallurgy, 313 Splaiul Independentei, 060042, District 6, Bucharest, Romania.
[2]National University of Science and Technology POLITEHNICA Bucharest, Department of Analytical Chemistry and Environmental Engineering, 1-7 Gh. Polizu Str., Polizu campus, 011061, District 1, Bucharest, Romania.
[3] National University of Science and Technology POLITEHNICA Bucharest, Advanced Polymer Materials Group, 1-7 Gh. Polizu Str., Polizu campus, 011061, District 1, Bucharest, Romania.

*mcn_aura@hotmail.com

Abstract. This study targeted the development of printable materials, using as platform the technology for converting bovine bone tissue into biogenic hydroxyapatite (HA). Composite filaments were obtained based on HA, antibiotics (ATB) and two different polymers (polylactic acid (PLA), and acrylonitrile butadiene styrene (ABS)). The composite materials were further synthesized by mechanical and thermal homogenization of different amounts of HA powder (particles <40 μm, 0-50 wt.%), ATB and GNP (0-5 wt.%), followed by incorporation into the PLA matrix [2]. Printable filaments were obtained by extrusion and then analysed in both surface and cross-section in order to outline the: (i) dispersion degree of the BHA and GNP materials into the PLA matrix, (ii) influence of both BHA and GNP materials on the surface features and mechanical behaviour and (iii) identification and elimination of deficient ratios at which the final samples properties are incompatible with the requirements of bone reconstruction applications.

Keywords: composite materials, printable features, antimicrobial features.

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Fabrication of Very Fine ZnS Nanoparticles through Surface Organo-Modification

Ionela Mădălina DUINEA[1,2], Aurel TĂBĂCARU[1*], Paul CHIRIȚĂ[2], Nicoleta CIOATERĂ[2], Alina-Mihaela CEOROMILA[3], Geta CÂRÂC[1*]

[1]Department of Chemistry, Physics and Environment, Faculty of Sciences and Environment, "Dunărea de Jos" University of Galați, 111 Domnească Street, 800201, Galați, Romania.
[2]Department of Chemistry, University of Craiova, 1071 Calea București, 200478, Craiova, Romania.
[3]Research and Development Center for Thermoset Matrix Composites, Cross-Border Faculty, "Dunărea de Jos" University of Galați, 111 Domneasca Street, 800201, Galați, Romania.

[*]aurel.tabacaru@ugal.ro, geta.carac@ugal.ro

Abstract. Surface modification of inorganic nanomaterials through functionalization with organic capping agents may be regarded as a very useful and hand-on strategy to avoid particle agglomeration, thus improving the current properties and even to design new ones [1]. In this context, we here report a simple, low-cost and high-yielding method for the fabrication of semiconductor zinc sulphide nanoparticles (ZnS NPs) by chemical co-precipitation, using the new capping agents tris(hydroxymethyl)aminomethane (TRIS) and 4-(2-ydroxyphenyl)-2-(morpholin-4-yl)-1,3-thiazole (DF). Powder X-ray diffraction (PXRD), scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX), Fourier transform infrared spectroscopy (FTIR) and UV–visible spectroscopy allowed to confirm the important effect of the adopted capping agents in the preparation of ZnS NPs with size reduction from *ca.* 40 nm in unmodified ZnS NPs to *ca.* 10 nm in ZnS NPs modified with either TRIS or DF capping agents.

Keywords: ZnS nanoparticles, organo-functionalization, chemical co-precipitation, morpho-structure, optical properties.

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Polymer Matrix Composites: A Short Review

Cristian-Stefan BUNDUC[1], Petrica VIZUREANU[1], Andrei-Victor SANDU[1], Costica BEJINARIU[1*]

[1]Gheorghe Asachi Technical University of Iasi, D. Mangeron 67, 700050, Iasi, Romania

[*]costica.bejinariu@academic.tuiasi.ro

Abstract. Recently, the use of polymer matrix composites has grown exponentially, substituting for conventional materials. The most important category of composite materials when it comes to the manufacture of personal protective equipment (PPE) are polymer matrix materials (PMM). PMMs are mainly used due to their low weight, high resistance to chemical attack, high elasticity, and superior thermal and electrical properties. These featured characteristics make them the most suitable choice in a wide range of industries, such as hybrid automotive, sports, packaging, aviation, military, and construction, especially due to their low curing time and simplicity in manufacturing. However, the key to creating composite materials that can be used to produce parts with complex shapes, low density, and improved physical and mechanical properties is the identification of the right reinforcing element for the polymeric matrix. The bond created between these two phases will result in a material with a tailored design and properties that can meet the requirements of PPE. This advantage is related to the unlimited combinations that can be obtained through the mixing of metallic, ceramic, or plastic elements with the polymer matrix. This study presents a brief overview of the literature that approaches the obtaining and applications of PMM. Accordingly, the relation between the composition (type or quantity of reinforcing elements and type matrix) and the properties of the PMM was analyzed, while showing the primary limitations in circular economy integration in industries with high consumptions of PMMs.

Keywords. polymer matrix, composite materials, circular economy, reinforcing elements, personal protective equipment.

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Fibre-based Soft Magnetic Composites. A New Concept for Designing High-Performance Composite Magnetic Cores

Bogdan Viorel NEAMTU[1*], Traian Florin MARINCA[1], Florin POPA[1], Mircea NASUI[1], Calin PRICA[1], Ionel CHICINAS[1]

[1]Competences Centre: Interfaces-Tribocorrosion-Electrochemical Systems (CC-ITES), Faculty of Engineering, Dunarea de Jos University of Galati, 47 Domneasca Street, RO-800008 Galati, Romania
[2]Department of Metallurgy and Materials Engineering, Katholieke Universiteit Leuven, Kasteelpark Arenberg 44, B-3001 Leuven, Belgium

[*]bogdan.neamtu@stm.utcluj.ro

Abstract. Today, more than 5 % of electricity consumption in the world is lost in the form of energy loss in devices such as transformers. The loss reduction, with a positive impact on the environment, can be achieved by the development of new materials with enhanced electromagnetic properties. Soft magnetic composites (SMCs) are a new class of materials designed in a way to combine the key advantages of the main classes of soft magnetic materials (high electrical resistivity of the ferrites and high saturation induction and permeability of the electrical steels). SMCs are prepared via powder metallurgy routes using ferromagnetic particles coated with a dielectric layer and then compacted. Recently, a new concept for designing SMCs was developed using ferromagnetic fibres instead of powders, i.e. Fibres-based Soft Magnetic Composites (FSMCs). This change leads to a significant enhancement of the electromagnetic properties of classic SMCs and will be the central point of the presentation.

Keywords: soft magnetic composites, fibres-based soft magnetic composites, cold sintering, magnetic properties.

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Particularities Regarding the Deposition of Hydroxyapatite through Electrical Impulse Discharges

Stefan Alexandru LAPTOIU[1], Mihai Ovidiu COJOCARU[1;2], Mihai BRANZEI[1], Marian MICULESCU[1]

[1]Department of Metallurgy and Materials Engineering, Politehnica University of Bucharest, Splaiul Independenței 313, București 060042, Romania
[2]Academia of Technical Science Romania

stefan.laptoiu@stud.sim.upb.ro

Abstract. The creation of strong adhesive layers of hydroxyapatite-based bioceramics (doped or undoped with pure bioinert metals, such as Ta, Ag, and Ti) on biocompatible metallic support offers a method for improving the local biofunctionalization of surfaces. The technology for processing electroconductive materials using electrical impulse discharges is particularly versatile, enabling the coating of strictly delimited areas of interest with perfectly adherent layers of various thicknesses. This study aims to quantify the effects of alternating the electrical power of the source generating the electrical impulse discharge and, the specific processing time per unit area of the cathode (made of titanium alloy) on the relative mass increase of the cathode. The anode was made of a mixture of hydroxyapatite powder with a self-polymerizing electroconductive acrylic resin injected into a tantalum sheath. Utilizing the experimental statistical method (central composite design for building a second-order orthogonal model), it was possible to quantify the effects of parameter adjustment (in the case of a single-layer deposition – the adherence layer), and the most significant difference in relative mass was shown with a low power value of the source, which assures the electrical discharge in impulse (5 W being the lower limit of the power considered), associated with the longest time specified for surface treatment (17,5 s/cm^2 on the surface of 4 cm^2) on a single layer.

Keywords: hydroxyapatite, electrical impulse discharge, biocompatible alloy, bioinert metals, doped bioceramic, experimental programming, relative mass variations, coating.

Corrosion Behaviour on Laser Surface Textured on AISI 430 Ferritic Stainless Steel

Edit Roxana MOLDOVAN[1, *], Liana Sanda BALTES[1], Catalin CROITORU[1], Elena Manuela STANCIU [1], Alexandru PASCU[1], Mircea-Horia TIEREAN[1]

[1]Transilvania University of Brasov, Materials Engineering and Welding Department, 29 Eroilor Blvd., 500036, Brasov, Romania

*edit.moldovan@unitbv.ro

Abstract. Stainless steel is widely used for its exceptional corrosion resistance, aesthetic appearance, and mechanical properties. Despite this, it can still stain and corrode under certain conditions [1]. Laser surface texturing was explored to enhance its corrosion resistance and surface properties. Implementing various techniques was observed to greatly enhance material corrosion behavior, leading to prolonged lifespan and improved performance. The use of laser surface texture on stainless steel significantly boosts corrosion resistance [2] and is credited to the micro-structures formed through laser texturing, which amplify surface area, minimize contact with corrosive substances, and facilitate the formation of a protective oxide layer. This paper focuses on the corrosion behavior and performance of stainless steel in NaCl 3.5 % solution using test methods such Raman spectroscopy, hardness, and optical microscopy. Implementing laser surface texturing techniques on stainless steel can greatly improve material corrosion behavior, leading to prolonged lifespan and improved performance. This advancement has had a significant impact on industries relying on stainless steel components, such as construction and automotive sectors.

Keywords: ferritic stainless steel, corrosion behavior, laser surface

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Analytical and Experimental Determination of the Modulus of Elasticity of the 75B Coating

Codrin-Dumitru CÎRLAN[1], Edmond LEVARDĂ[1], Marius PETCU[1], Stefan Lucian TOMA[1]*

[1]"Gheorghe Asachi" Technical University of Iasi, Materials Engineering and Industrial Safety Department, No. 67 Prof. D. Mangeron Blvd., 700050, Iasi, Romania

*stefan-lucian.toma@academic.tuiasi.ro

Abstract. In the present study, the mechanical properties of thermal sprayed wire arc coating of super alloy 75B were investigated. The elastic modulus of the coating was experimentally determined using Knoop indentation, resonant frequency, tensile test, three-point bending test, and nano-indentation. In addition, the elastic modulus was calculated using numerical simulations and by use of available analytical methods. Thermally sprayed depositions exhibit anisotropic structure resulting in different mechanical properties in the transverse and longitudinal directions. Some of the techniques used in this study are only capable of determining properties in one direction. However, Knoop indentation and image based finite element analysis can measure and predict the elastic modulus in both directions. Comparison of the results obtained from the analytical models, numerical simulations, and experimental tests lead to better understand of the capabilities and accuracy of each method in prediction and measurement of mechanical properties of thermal spray coating structures.

Keywords: arc spraying process, elastic modulus, alloy 75B.

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General Overview of BHR Prosthesis and Possible Causes of Their Failures

Niculae VĂLEANU[1], Larisa POPESCU[1*], Iuliana CORNESCHI[1], Marian MICULESCU[1], Catalin Ionel ENACHESCU[2]

[1]University POLITEHNICA of Bucharest, Faculty of Material Science and Engineering, Department of Materials Science and Physical Metallurgy, 313 Splaiul Independentei Street, 060042, Bucharest, Romania
[1]Elias Emergency University Hospital, Department of Dermatology, Bucharest, Romania

[*]niculae.valeanu@stud.sim.upb.ro

Abstract. The aim of this research is to identify the prevalence of failure for Birmingham Hip Prosthesis (BHR) in total hip arthroplasty and to analyse the reasons for it. We introduce our current analysis on a series of different BHR retrieved prosthesis after premature failure. Relevant data from radiographs, intraoperative images, and case studies was analyzed to better understand the factors involved in BHR prosthesis failure. A closer investigation revealed the presence of a crack originating from the gap between the cement mantle and bone. Detailed analysis of the failure highlighted uneven cement distribution, with overloading in certain areas and the formation of voids in the material. Additionally, SEM analyses were conducted as part of the investigation to examine in detail the bone cement morphology and better understand the interactions at the interfaces between implant-cement-bone.
In conclusion, this research emphasizes the importance of surgical technique planning and cementation procedure in the success rate of BHR prosthesis. It also underscores the need for careful evaluation of patient characteristics and bone quality to minimize the risk of BHR prosthesis failure.

Keywords: metallic biomaterials, BHR prosthesis, failure analysis, bone cements, SEM, cementation techniques.

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Applying of Calcium Phosphate Conversion Coatings for Biomedical Aims

Dimka FACHIKOVA[1*], Gergana ILIEVA[1], Daniela LILOVA[1]

[1]University of Chemical Tehnology and Metallurgy, 8 Kliment Ohridski Blvd., 1756 Sofia, Bulgaria

[*]dimkaivanova@uctm.edu

Abstract. The mechanical strength, good adhesion to the substrate, and high corrosion stability in the human body of calcium phosphate conversion coatings applied to metal implants, makes them widely used for biomedical aims. The proposed work presents the results obtained during phosphating of high nitrogen stainless steel specimens in a calcium-containing phosphating solution. The main characteristics - density, pH, electrical conductivity, total and free acidity of the phosphating preparation, as well as the influence of the concentration and temperature of the working solutions on the kinetics of the coatings were determined. The surface morphology of the coatings was investigated using scanning electron microscopy (SEM). The chemical state and atomic composition were determined using energy dispersive spectroscopy (EDS) and X-ray photoelectron spectrometer (XPS), respectively. The behavior of calcium phosphate coatings on high nitrogen stainless steel in model physiological solutions similar to those in the human body were also investigated.

Keywords: biocompatibility, high nitrogen steels, phosphating, corrosion, electrochemical methods.

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Phosphating of Carbon Steels in Zinc - Manganese Phosphate Concentrates

Nona SHIVACHEVA[1*], Gergana ILIEVA[1], Dimka FACHIKOVA[1]

[1]University of Chemical Tehnology and Metallurgy, 8 Kliment Ohridski Blvd., 1756 Sofia, Bulgaria

[*]nshivacheva@abv.bg

Abstract. The phosphating of metals, originally intended mainly for their protection against corrosion using relatively thick layers, is one of the most important and widely used forms of metal pretreatment. Its range of applications has nowadays expanded considerably to include its use as solid lubricants in wire drawing, calibration and cold forming of metals, for electrical insulating coatings, as a sublayer prior to the application of varnish and polymer coatings, etc. The results obtained by phosphating of low carbon steel in Zn – Mn phosphate concentrates with different ratios of zinc and manganese phosphates contained therein, are presented in the proposed work. The main parameters characterizing the preparations - density, pH, electrical conductivity, total and free acidity have been determined. The influence of temperature and concentration of phosphating solutions on the mass/thickness of the coatings and on the dissolved metal of the substrate, depending on the duration of the phosphating process, was investigated. The structure, elemental and phase composition of the Zn – Mn phosphate coatings obtained were determined by various physical – analytical methods.

Keywords: phosphating, conversion coatings, steel surfaces, corrosion.

Acknowledgement: Financial support of the NATIONAL PROGRAMME "YOUNG SCIENTISTS AND POSTDOCTORAL FELLOWS 2", 2022 is gratefully acknowledged.

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Kinetics and Characterization of Phosphate Coatings Prepared on Aluminum Surfaces

Zdravka DJUMAILIEVA[1*], Tsvetelina LIUBENOVA[1], Gergana ILIEVA[1], Dimka FACHIKOVA[1]

[1]University of Chemical Tehnology and Metallurgy, 8 Kliment Ohridski Blvd., 1756 Sofia, Bulgaria

[*]z_slaveva@abv.bg

Abstract. The proposed work presents the results obtained in the complex study of the electrochemical formation processes of thin phosphate coatings on aluminum alloy AA1050. The mass/thickness of phosphate films were determined by gravimetric measurements under the following conditions: concentration of working solutions 2.0÷11.0 vol%; process duration 1.0÷10.0 min; medium temperature range 20.0÷70.0°C; cathodic current density 0.1÷0.5 Adm^{-2}. Using energy-dispersive X-ray spectroscopy (EDX), scanning electron microscopy (SEM), potentiodynamic-polarization method (PDPM), and electrochemical impedance spectroscopy (EIS), the elemental composition, morphology, topography, corrosion behavior and respectively a protective ability of the obtained phosphate coatings, were determined.

Keywords: aluminum alloys, conversion coatings, phosphating, tin films, corrosion.

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EDX Analysis of Three Composite Resins Used in Periodontal Splints

Ionut LUCHIAN[1], Dragos Nicolae FRATILA[1], Dragos Ioan VIRVESCU[1], Dana Gabriela BUDALA[1*]

[1]Gr.T. Popa U.M.Ph. - Iași, Faculty of Dentistry, Iasi, Romania

[*]danab1978@yahoo.com

Abstract: Our interes was to assess the properties of three different composite resins used in periodontal immobilization systems: G-aenial Flo X (GC Corporation, Tokyo, Japan), GrandioSO (VOCO, Cuxhaven, Germany), and Clearfil Majesty ES flow (Kuraray Noritake Dental Inc., Okayama, Japan). The structural investigations were conducted using a QUANTA 200 3D scanning electron microscope (FEI, Netherlands). The elemental composition of the materials was determined by X-ray spectroscopy with energy dispersion (EDX). The findings indicated that the GrandioSO composite exhibited the highest level of resistance in terms of its nonporous structure. This can be attributed to the presence of a uniform matrix with low concentrations of silicon and carbon. Additional investigation is necessary to examine the mechanical characteristics of these resins and their response in various biological settings, both in laboratory conditions and within living organisms.

Keywords: composite resins, EDX, SEM, periodontal splint.

$Fe_{35}Co_{20}Ni_{20+x}Si_{10}Mo_{8-x}Cu_7$ (x=0, 3) Soft Magnetic High Entropy Alloys Obtained by Mechanical Alloying

Emrah KARAÇAY[1], Traian Florin MARINCA[1],
Virigiliu Calin PRICĂ[1], Florin POPA[1],
Bogdan Viorel NEAMŢU[1], Ionel CHICINAŞ[1*]

[1]Technical University of Cluj-Napoca, Materials Science and Engineering Department, 103-105 Muncii Ave., Romania

[*]ionel.chicinas@stm.utcluj.ro

Abstract. High Entropy Alloys (HEAs) are alloys with five or more elements, and each element has an atomic concentration between 5% and 35% [1,2]. The aim of this study is to obtain Soft Magnetic High Entropy Alloys by mechanical alloying. Two different compositions were used for this: $Fe_{35}Co_{20}Ni_{20}Si_{10}Mo_8Cu_7$ and $Fe_{35}Co_{20}Ni_{23}Si_{10}Mo_5Cu_7$ (at.%). Mechanical alloying (MA) employing a Fritsch Pulverisette 6 planetary ball mill yielded soft magnetic HEAs. Elemental powders of Fe, Co, Ni, Si, Mo, and Cu were utilized as raw materials. MA experiments were conducted in an argon atmosphere in a hardened stainless steel vial. The BPR was 10:1. Milling time was for $Fe_{35}Co_{20}Ni_{20}Si_{10}Mo_8Cu_7$ 1h, 2h, 4h, 8h, 12h, 16h, 20h, 24h, 28h, 32h, 72h, 100h and for $Fe_{35}Co_{20}Ni_{23}Si_{10}Mo_5Cu_7$ 20h, 32h, 72h. The alloy formation evolution was studied by X-ray diffraction in an angular range of 2θ= 20–110°, using an INEL 3000 diffractometer and working with Co radiation). The milled powders consist of two solid solutions, one centred on Fe and the other on Mo. Scanning electron microscopy and X-ray microanalysis examined particle morphology and chemical homogeneity. The mechanically alloyed powders will be compacted by spark plasma sintering to study the soft magnetic properties in DC and AC regimes.

Keywords: high entropy alloys, soft magnetic materials, mechanical alloying, X-ray diffraction, SEM, EDX.

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Experimental and Prediction Studies of Carboxymethylcellulose as a Corrosion Inhibitor for Mild Steel in Seawater

Mohammad Fakhratul Ridwan ZULKIFLI[1*], Wan Mohd Norsani WAN NIK[1], Suriani MAT JUSOH[1], Adi Hafizamri ARIFFIN[1], Samsuri ABDULLAH[1], Mohd Ikmar Nizam MOHAMAD ISA[2]

[1]Marine Materials Research Group, Faculty of Ocean Engineering Technology, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[2]Energy Storage Research, Advanced Material Team, Ionic & Kinetic Materials Research (iKMaR), Faculty of Science and Technology, Universiti Sains Islam Malaysia, 71800 Nilai, Negeri Sembilan, Malaysia

[*]fakhratulz@umt.edu.my

Abstract. The issue of mild steel corrosion in seawater poses a significant problem across maritime, offshore, and coastal infrastructure. One potential solution for addressing this issue involves the use of corrosion inhibitors. Due to the increasing number of environmental regulations imposed by various nations, the development of environmentally-friendly corrosion inhibitors has emerged as a pressing issue. Hence, in this study, we aim to assess the effectiveness of Carboxymethyl Cellulose (CMC) inhibitors in preventing mild steel corrosion in seawater, utilizing experimental analysis and artificial neural networks (ANN). Our experimental phase involves immersing mild steel samples for 5 hours in seawater at different inhibitor concentrations. CMC was found to inhibit corrosion with the highest efficiency recorded at 58% at room temperature. Increasing temperature significantly reduces the inhibition efficiency. Experimental procedures, however, can be a challenging, expensive, and time-consuming process.

Keywords: neural network, carboxymethyl cellulose, corrosion inhibitor.

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Flammability of Woven Kenaf/Fibreglass Reinforced Polyester Hybrid Composites via Experimental and Response Surface Methodology

Suriani MAT JUSOH[1*], Mohammad Fakhratul Ridwan ZULKIFLI[1], Samsuri ABDULLAH[1], Che Mohd Ruzaidi GHAZALI[1], Nik Adib NIK ABDULLAH[2], Andrei Victor SANDU[3]

[1]Faculty of Ocean Engineering Technology, Universiti Malaysia Terengganu, 21300 Kuala Nerus, Terengganu, Malaysia
[2]MSET Iflatable Composit. Corporation Sdn. Bhd., Gong Badak Industrial Zone, 21300 Kuala Nerus, Malaysia
[3]Faculty of Material Science and Engineering, Gheorghe Asachi Technical University of Iasi, 41D. Mangeron St., 700050 Iasi, Romania
[4]Romanian Inventors Forum, Str. Sf. P. Movila 3, 700089 Iasi, Romania.
[5]National Institute for Research and Development for Environmental Protection INCDPM, 294 Splaiul Independentei, 060031 Bucharest, Romania

*surianimatjusoh@umt.edu.my

Abstract. Natural fibres such as Kenaf fibre have increased in demand due to their durability, eco-friendliness, and low cost of production. However, it has major drawbacks that lead to the degradation of composite properties, including high flammability. To fix these drawbacks, researchers had suggested some solutions to make this Kenaf fibre reinforced composite at its best, which include estimating the optimum weight percentage of fibre content reinforced composite to reduce the risk of fire raging and limit its flammability properties. Previous research experiments were done by comparing the burning rates of composite specimens with different fibre contents. In this study the optimum weight percentage of fibre contents for the flammability properties was determined via Response Surface Methodology (RSM). There were three objectives for this research as to determine the optimum parameter of flammability properties via RSM, to fabricate Woven Kenaf/Fibreglass reinforced polyester (WKFRP) using hand lay-out technique at optimum weight percentage of fibre content reinforced composite and to investigate the flammability properties of Woven Kenaf/ Fibreglass reinforced polyester (WKFRP) via experimental methods.

Keywords: flammability, hybrid composites, kenaf fibre, natural fibre.

Enhancing Biogas Purification Productivity Using Calcium Alginate Beads Embedded with Microbial Biomass

Mohammad Nasrun IBRAHIM[1], Mohammad Anuar KAMARUDDIN[1*], Norazian Mohamed NOOR[2]

[1]Environmental Technology Division, School of Industrial Technology, Universiti Sains Malaysia
[2]Faculty of Civil Engineering & Technology, Universiti Malaysia Perlis (UniMAP), Perlis, Malaysia

[*]anuarkamaruddin@usm.my

Abstract. Biogas is a highly efficient and beneficial energy source. Biogas is an energy source generated from the anaerobic decomposition of organic materials by bacteria. The anaerobic digestion (AD) process generates biogas, which presents significant economic and environmental benefits. The raw biogas produced from AD is lacking in quality as it contains methane (CH4), carbon dioxide (CO2), hydrogen sulfide (H2S) and other impurities. This poses challenges for its efficient utilization and requires a purification step to remove impurities. This research aims in enhancing the biogas produced by using microbial biomass embedded in calcium alginate beads. The microbial biomass will be taken from the AD byproduct which is the digestate. The calcium alginate beads will be prepared with a few types of ratios between sodium alginate and digestate. These beads are then used to purify the biogas by letting the gas flow through the beads. The effectiveness of the method depends on the changes in the concentrations of CH4, CO2, and H2S in the treated gas. By eliminating the CO2 and H2S the percentage of CH4 will increase, so does the quality of the biogas produced.

Keywords: anaerobic digestion, biogas purification, biogas application.

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Microstructural and Strength Evolutions of Kaolin Geopolymer Based Ceramics at Different Sintering Temperature

Nur Bahijah MUSTAPA[1], Romisuhani AHMAD[1*,2], Wan Mastura Wan IBRAHIM[1,2], Mohd Mustafa Al bakri ABDULLAH[2], Andrei Victor SANDU[3], Selva Vinayakkan A/L SURES[1]

[1]Faculty of Mechanical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 01000 Perlis, Malaysia
[2]Center of Excellence Geopolymer and Green Technology (CEGeoGTech), Faculty of Chemical Engineering; Technology, Universiti Malaysia Perlis (UniMAP), 01000 Perlis, Malaysia
[3]Faculty of Material Science and Engineering, Gheorghe Asachi Technical University of Iasi, 700050 Iasi, Romania

[*]romisuhani@unimap.edu.my

Abstract. Ceramic materials generated by combining compacting and sintering have become more essential in the current industry according to the superior mechanical and physical properties. This research aims to understand the effects of different sintering temperatures on kaolin geopolymer based ceramics and explore their microstructure and strength evolution under varying sintering temperature (100°C, 300°C, 500°C, 700°C, 900°C and 1100°C). XRF analysis underscores the dominance of silicon oxide (SiO_2) and aluminum oxide (Al_2O_3) in the geopolymer structure while XRD patterns reveal a dynamic shift in crystalline phases, with nepheline emerging dominantly at higher temperatures. SEM analysis vividly illustrates structural changes, emphasizing increased density and reduced porosity as temperatures rise. Flexural strength peaks at 1100°C, aligning with heightened density, indicating optimal sintering temperature.

Keywords: geopolymer, geopolymer based ceramics, ceramics, sintering.

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Effect of Sintering Temperature on Structural, Physical and Mechanical Properties of the Activated-HAp Ceramic

Wan Mohd Arif W. IBRAHIM[1,2], Mohd Mustafa Al Bakri ABDULLAH[1,2], Noorina Hidayu JAMIL[1,3], Hasmaliza MOHAMAD[4], Mohd Arif Anuar Mohd SALLEH[1,2], Petrica VIZUREANU[5]

[1]Centre of Excellence Geopolymer and Green Technology (CEGeoGtech), Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[2]Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[3]Faculty of Mechanical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[4]School of Materials and Mineral Resources Engineering, Engineering Campus, Universiti Sains Malaysia (USM), 14300 Nibong Tebal, Pulau Pinang, Malaysia
[5]Faculty of Material Science and Engineering, Gheorghe Asachi Technical University of Iasi, 700050 Iasi, Romania

*wmarif@unimap.edu.my ; mustafa_albakri@unimap.edu.my

Abstract. This study investigates the influence of varied sintering temperatures on the structural, physical, and mechanical properties of activated-hydroxyapatite (HAp) ceramic, with a focus on its potential implications for biomedical applications. Activated metakaolin (MK)/HAp specimens were prepared using an alkaline activation technique, maintaining a fixed metakaolin loading in HAp at a liquid-to-solid (L/S) ratio of 1.25. Phase analysis revealed the formation of multiple crystalline phases within the sintering temperature range of 800°C to 1100°C, while sintering at 900°C resulted in the formation of a single monoclinic hydroxyapatite phase, exhibiting the highest recorded diametrical tensile strength of 12.52 MPa. X-ray diffraction (XRD) results also indicated the presence of a semi-crystalline phase at 1200°C, consistent with crystallization peak temperatures (Tp) of 1070°C observed in thermal analysis.

Keywords: alkali-activated hydroxyapatite, hydroxyapatite phase

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Micro-Characterization of Ternary Geopolymers with Fly Ash, Red Mud and Flue Gas Desulfurization Waste

Dumitru Doru BURDUHOS NERGIȘ[1], Andrei Victor SANDU[1,2], Madalina-Simona BALTATU[1], Dragos Cristian ACHITEI[1], Manuela-Cristina PERJU[1], Diana Petronela BURDUHOS-NERGIS[1], Petrica VIZUREANU[1,3*]

[1]Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University of Iasi, 67 Prof. D. Mangeron Blvd., 700050 Iasi, Romania
[2] Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, 050094 Bucharest, Romania
[3]Technical Sciences Academy of Romania, 26 Dacia Blvd., 030167 Bucharest, Romania

[*]peviz2002@yahoo.com

Abstract. Geopolymers are now being extensively investigated as possible substitutes for materials based on Ordinary Portland Cement. Previously, geopolymer research was limited to the use of natural raw materials, such as kaolin, metakaolin, or calcined clays, but has since expanded to include a variety of by-products, such as fly ash, blast furnace slag, etc. The unique advantages of employing waste as raw materials in terms of the environment and economy have promoted this change. This study investigates the microstructural characteristics of three types of waste (red mud, fly ash, and flue gas desulfurization waste) used as raw materials in geopolymers. To reveal the relationship between raw material composition, activator type, and mechanical properties of ternary geopolymers, the surface morphology of nine different mixtures was evaluated. Therefore, scanning electron microscopy, optical microscopy, and energy-dispersive X-ray spectroscopy have been used to perform the evaluation. According to the results, there is a clear relationship between cracks, pores, unreacted particles, and etherogenity of the analised surface and the mechanical performance of the geopolymers.

Keywords: geopolymers; red mud; fly ash; flue gas desulphurization waste.

Corrosion Behaviour of Ca-Zn Phosphate Coating Deposited on Ti6Al4V

Diana-Petronela BURDUHOS-NERGIS[1], Petrica VIZUREANU[1,*], Andrei Victor SANDU[1], Dumitru-Doru BURDUHOS-NERGIS[1], Costica BEJINARIU[1,*]

[1]"Gheorghe Asachi" Technical University of Iasi, Faculty of Materials Science and Engineering, 41 "D. Mangeron" Street, 700050, Iasi, Romania

*peviz@yahoo.com; *costica.bejinariu@yahoo.com

Abstract. Currently, one of the priorities in the biomedical field is the continued improvement of materials and obtaining methods, especially due to their importance to human health. Therefore, the deposition of phosphate layers through chemical conversion processes is one of the technologies intensively studied in order to improve the surface and chemical properties of metals suitable for medical implants. Nowadays, this type of coating is applied to metal alloys such as iron, zinc, magnesium, and titanium. The most commonly used are those based on zinc-calcium or zinc-strontium. Despite the fact that titanium and its alloys are some of the most commonly used metallic biomaterials, some toxic corrosion products can be produced during their contact with body fluids. This study aims to improve the corrosion resistance of Ti6Al4V by depositing a conversion layer of Ca-Zn phosphate on its surface. Accordingly, the corrosion behavior of the coating and the Ti6Al4V is studied in two types of corrosive media (Ringer and Dulbecco solutions) by cyclic voltammetry and electrochemical impedance spectroscopy (EIS). The results show a significant improvement in the corrosion resistance of Ti6Al4V by covering its surface with a Ca-Zn phosphate layer.

Keywords: Ca-Zn phosphate layer, conversion coating, titanium alloys, corrosion resistance, cyclic voltammertry, EIS.

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EURO
INVENT

SECTION 2

PROCEDURES AND TECHNOLOGIES FOR MATERIALS ENGINEERING

Insights into New Materials for Stab Vests

Georgeana CĂPĂȚÎNĂ[1], Petrica VIZUREANU[1,2], Madalina Simona BALTATU[1], Andrei Victor SANDU[1,3*], Dragos Cristian ACHITEI[1], Bogdan Andrei ROTARU[1]

[1] Gheorghe Asachi Technical University of Iasi-Romania, Faculty of Materials Science and Engineering, 41 Prof. D. Mangeron Blvd., 700050, Iasi, Romania
[2]Technical Sciences Academy of Romania, Dacia Blvd 26, 030167 Bucharest, Romania
[3]Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, 050094 Bucharest, Romania

[*]sav@tuiasi.ro

Abstract. Stab vests are crucial for the protection of military personnel, law enforcement and other professionals exposed to the risk of attack with white weapons. However, the traditional materials used in these vests have certain limitations in terms of weight, flexibility, and impact absorption effectiveness. Therefore, there is an increased need for the development of new and improved materials that provide more effective and more comfortable protection. The aim of this study is to explore and develop new materials for anti-stab vests, using an integrated approach that combines modern technologies for the development of new materials and structural characterization, but also performance evaluation. This study will provide new insights into material development for anti-stab vests by identifying promising composite materials. It is also expected to yield materials with an optimal combination of puncture resistance, flexibility, and comfort, with the potential to surpass the performance of traditional materials used today. Thus, by integrating advanced knowledge in the field of materials science and engineering, this study proposes to advance the development of innovative materials for anti-stab vests, contributing to improving the safety and comfort of personnel exposed to the risks of attack with white weapons.

Keywords: stab vests, composite materiale, optimal characteristics

Titanium: The Metal Shaping Modern Medicine, Aerospace and Automotive Industries

Marius Albert MAZILU[1], Ion GHICULESCU[1], Petrică VIZUREANU[1,2*], Madalina Simona BALTATU[1]

[1] Gheorghe Asachi" Technical University of Iasi-Romania, Faculty of Materials Science and Engineering, 41 Prof. D. Mangeron Blvd., 700050, Iasi, Romania
[2] Technical Sciences Academy of Romania, Dacia Blvd 26, 030167 Bucharest, Romania

[*]peviz2002@yahoo.com

Abstract. Titanium stands as a pivotal material in advancing human life quality, thanks to its unparalleled properties. This study illuminate's titanium's versatility, highlighting its high strength-to-weight ratio, outstanding corrosion resistance, and biocompatibility, which render it indispensable across aerospace, medical, and automotive industries. In aerospace, its low density and robustness are crucial for aircraft parts, while its biocompatibility ensures its preference for medical implants and tools. Moreover, its application in automotive manufacturing promotes fuel efficiency and reduced emissions. This overview affirms titanium's integral role in modern engineering and medical fields, suggesting its continued relevance in future technological and biomedical advancements.

Keywords: titanium, applications, biocompatibility, aerospace, medical implants

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Advancing Biomedical Applications: Ti-Mo-Nb-Sn Alloys

Petrica VIZUREANU[1,2*], Madalina Simona BALTATU[1], Andrei Victor SANDU[1,3], Dragos Cristian ACHITEI[1], Manuela Cristina PERJU[1], Dumitru Doru BURDUHOS-NERGIS[1]

[1] Gheorghe Asachi" Technical University of Iasi-Romania, Faculty of Materials Science and Engineering, 41 Prof. D. Mangeron Blvd., 700050, Iasi, Romania
[2] Technical Sciences Academy of Romania, Dacia Blvd 26, 030167 Bucharest, Romania
[3] Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, 050094 Bucharest, Romania

[*]peviz2002@yahoo.com

Abstract. The development of titanium alloys for biomedical applications represents a forefront of materials science research, seeking to optimize the balance between strength, ductility, and biocompatibility. Among these, Ti-Mo-Nb-Sn alloys have emerged as a promising class of materials, offering unique advantages for orthopedic and dental implants. This paper reviews the state-of-the-art of Ti-Mo-Nb-Sn alloys, focusing on their composition, microstructural characteristics, mechanical properties, and corrosion resistance. It highlights recent advancements in alloy development, processing techniques, and their impact on enhancing osseointegration and minimizing implant-related complications. By providing a comprehensive overview, the study underscores the potential of Ti-Mo-Nb-Sn alloys to redefine standards in implantology and invites further research to unlock their full capabilities in medical applications.

Keywords: Ti-Mo-Nb-Sn alloys, biomedical applications, orthopedic implants, microstructure, mechanical properties

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Research Progress on the Complex Analysis of Top Cobalt and Titanium-Based Biomaterials

Mihai TOFAN[1], Petrica VIZUREANU[1,2*], Madalina Simona BALTATU[1], Mirabela MINCIUNA[1]

[1] Gheorghe Asachi" Technical University of Iasi-Romania, Faculty of Materials Science and Engineering, 41 Prof. D. Mangeron Blvd., 700050, Iasi, Romania
[2] Technical Sciences Academy of Romania, Dacia Blvd 26, 030167 Bucharest, Romania

[*]peviz2002@yahoo.com

Abstract. The study delves into the latest advancements in cobalt and titanium-based biomaterials, exploring their remarkable potential and significance within the medical domain. Renowned for their exceptional strength, resilience, and biocompatibility, these materials serve as foundational elements in the development of cutting-edge implants and devices, striving to emulate the intricate functions of human tissues. This comprehensive analysis further examines their utilization across various medical disciplines, encompassing orthopedics, dentistry, and cardiovascular interventions. Moreover, the study sheds light on the continuous research endeavors dedicated to refining their properties, ensuring alignment with the intricate requirements of biomedical applications in a dynamic healthcare landscape.

Keywords: cobalt-based biomaterials, titanium-based biomaterials, medical implants, biocompatibility, material properties, biomedical applications

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A Comparative Study of Ti-Mo-Zr-Ta and Ti_6Al_4V Alloy

Ion GHICULESCU[1], Petrica VIZUREANU[1,2*], Dumitru-Doru BURDUHOS-NERGIS[1], Madalina Simona BALTATU[1]

[1] Gheorghe Asachi" Technical University of Iasi-Romania, Faculty of Materials Science and Engineering, 41 Prof. D. Mangeron Blvd., 700050, Iasi, Romania
[2] Technical Sciences Academy of Romania, Dacia Blvd 26, 030167 Bucharest, Romania

[*]peviz2002@yahoo.com

Abstract. Titanium and its alloys are of increasing interest for use in medical applications because they present important characteristics required of implant materials, namely, good mechanical properties (lower modulus of elasticity than stainless steel or CoCr alloys, fatigue resistance, resistance to corrosion), high biocompatibility. These materials have multiple uses in orthopedics, dentistry, maxillofacial surgery, cardiovascular surgery.
In this work, two Ti-Mo-Zr-Ta titanium alloys are studied compared to the classic Ti6Al4V alloy. These titanium-based alloys that overcome the disadvantages of Co-Cr alloys and stainless steels. The new variant of alloys contains different values of the alloying percentage of some non-toxic elements (Mo, Zr, Ta) in order to improve the mechanical properties (mechanical resistance, modulus of elasticity), alloys that have in mind a good resistance to corrosion, as well as biocompatibility appropriate.

Keywords: titanium-based biomaterials, medical implants, biocompatibility, material properties, biomedical applications

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Titanium Surface Nano-Structuring and Activation with Active Radicals

Mariusz WINIECKI[1*], Piotr KRAWCZYK[2]

[1]Department of Constructional Materials and Biomaterials, Faculty of Materials Engineering, Kazimierz Wielki University, Jan Karol Chodkiewicz Street 30, 85-064 Bydgoszcz, Poland
[2]Institute of Chemistry and Technical Electrochemistry, Faculty of Chemical Technology, Poznan University of Technology, Berdychowo 4, 60-965 Poznan, Poland

[*]winiecki@ukw.edu.pl

Abstract. Due to their excellent biocompatibility, titanium (Ti) and its alloys are widely used as implant material in orthopaedic and dental fields. Since the untreated Ti is not particularly bioactive, it requires surface modification regarding the enhancement of biological response in terms of osseointegration, while simultaneously providing appropriate antibacterial action. Current research in the field of engineering peri-implant osteoprocesses is aimed at improving the functional properties of the implant's bone-contacting surfaces. The research work aims at Ti-alloy surface functionalization with the new method of modification performed by its ozonation in a liquid phase. During the advanced oxidation of a Ti-alloy surface by active radicals, there are occurring specific changes of its surface composition (the Ti–OH bonds, Ti-peroxy and peroxide complex functionalities are formed) and its nanostructure (the TiO_2 nano-network is formed). The pro-osteogenesis response and antibacterial action are projected based on the preliminary research results for these effects. Apart from this, the activation and nano-structuring of Ti-alloys effected by the proposed new modification method creates new possibilities for further surface multifuntionalisation targeting implant surface tailoring to improve bone regenerative capacity.

Keywords: surface modification, nanostructured surface, ozone treatment, active radicals, titanium oxides

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Life Cycle Assessment of Geopolymers obtained from Bulgarian Industrial Wastes

Nina PENKOVA[1], Andriana SURLEVA[1],
Kalin KRUMOV[1*], Daria ILIEVA[1]

[1]University of Chemical Technology and Metallurgy, Sofia, Bulgaria

[*]kkrumov@uctm.edu

Abstract. A computational algorithm for material and energy balance of a technology for production of geopolymers from fly ash at coal combustion, copper mine tailings and sodium silicate solution is developed. It is applied for determining of utilized wastes, embodied energy and carbon footprint of the products. The initial, critical and equilibrium moisture content of the geopolymers, the drying shrinkage and the energy consumption for the process at industrial conditions are obtained by experimental drying. Options for free drying in environmental conditions in order to save energy are discussed. The influence of the shrinkage during the casting of the geopolymer bodies on their design and use in the construction is considered. The research is a continuation of the achievements of an international team that developed the technology for obtaining geopolymers during the implementation of a Project КП-06-ДО 02/5 “RecMine – Environmental footprint reduction through eco-friendly technologies of mine tailings recycling”, funded by Bulgarian Ministry of Education and Science and ERA-Min3 program.

Keywords: geopolymers, waste utilisation technology, fly ash, mine tailing, material balance, drying, shrinkage, embodied energy

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Research on the Impact Behaviour of Trip Steels

Andrei Constantin BERBECARU[1], George COMAN[1], Ecaterina MATEI[1], Andra PREDESCU, Mirela SOHACIU[1], Sorin CIUCA[1], Cristian PREDESCU[1]

[1] Faculty of Materials Science and Engineering, National University of Science and Technology POLITEHNICA Bucuresti, 313 Splaiul Independentei, RO-060042 Bucuresti, Romania

[*]andrei.berbecaru@upb.ro

Abstract. The paper presents research carried out to improve the impact behaviour of TRIP steels by establishing suitable chemical compositions to ensure a majority transformation of residual austenite to martensite. The high ductility of TRIP steels has a positive influence for their use in the manufacture of impact energy absorbing components in automobiles. The stability and amount of residual austenite in TRIP steel are of particular importance to achieve this high ductility and to ensure that a large amount of energy is absorbed in the event of a crash. It is obvious that if all the residual austenite is converted to martensite during the impact forming stage. This is mainly due to the fact that in TRIP steels, brittle martensite with high carbon are formed, which makes the steel prone to failure during a crash. For maximum benefit, the residual austenite must have a reasonable resistance to deformation-induced transformation during the impact forming stage, and in the event of a crash, most of the residual austenite must convert to martensite under impact shock and absorb a large amount of energy.

Keywords: trip steel, residual austenite, automobile

Acknowledgements: This work was supported by a grant from the National Program for Research of the National Association of Technical Universities - GNAC ARUT 2023

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Corrosion Behavior in Aqueous Environments of Martensitic Stainless Steels Used in Hydropower Turbine Blades

George COMAN[1*], Andrei BERBECARU[1], Mirela SOHACIU[1], Ecaterina MATEI[1], Andra PREDESCU[1], Sorin CIUCA[1], Cristian PREDESCU[1]

[1] Faculty of Materials Science and Engineering, National University of Science and Technology POLITEHNICA Bucuresti, 313 Splaiul Independentei, RO-060042 Bucuresti, Romania

[*]george.coman@upb.ro

Abstract. The paper presents the results of research carried out on three samples of martensitic stainless steel used in the manufacture of hydropower turbine blades. The experiments were carried out under normal aeration conditions at ambient temperature (22 degrees C) in freshly prepared solutions of 1N potassium sulfate and 3% NaCl.[1] Analysis of the results regarding the corrosion behavior in Cl-free environments coupled with the microstructural information obtained by SEM highlights very good corrosion resistance properties (very good resistance class) as well as the appropriate passivation of the surface. This recommends the three steels for use in the construction of hydropower turbine blades. The negative influence of chlorine on the surface is highlighted by reducing the degree of passivation by half, which does not recommend the use of this material in a saline environment. Analysis of the surfaces of the three samples by AFM microscopy, after the cavitation process, revealed a gradual decrease in the surface roughness due to the damage caused by cavitational corrosion and a tendency to stabilize the surface noted by decreasing the level differences between the point of maximum surface height and the minimum.

Keywords: martensitic steel, corrosion, hydro, blades, passivation

Acknowledgements: This work was supported by a grant from the National Program for Research of the National Association of Technical Universities-GNAC ARUT 2023

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Electrochemically Texturing of Ti6Al4V Alloy to Improve Implant's Surface Properties in Biological Solutions

Lidia BENEA[1]*, Veaceslav NEAGA[1]

[1]Competences Centre: Interfaces-Tribocorrosion-Electrochemical Systems (CC-ITES), Faculty of Engineering, Dunarea de Jos University of Galati, 47 Domneasca Street, RO-800008 Galati, Romania

*lidia.benea@ugal.ro

Abstract. The surface of a biomaterial is the first component of the implant that comes into contact with cells or biological fluids during applications in human body. The paper presents a correlation of the surface properties of the Ti6Al4V alloy untreated and electrochemically oxidized in order to form a nanoporous surface structure. From the analysis of nanoporous surface it could be possible to appreciate the nanopores diammeter and uniformly distribution of electrochemically formed pores on alloy surface. The mean diammeter of electrochemically formed pores is between 0.8 nm and 2.88 nm (nanometers), being slightly dependent on oxidation time and imposed potential. The pore diammeter's are also correlated with high voltage imposed as well as the treatment time. The oxigen concentration on oxidised titanium alloy surface is quantified inside of pores as well as near the pores (or the surface between electrochemically formed pores). The resulted modified titanium alloy is further investigated for anticorrosion properties in physiological solution and in extreme conditions by doping physiological solution with albumin and reactive oxygen species which could be present in biological fluids during body infection periods. In the case of the electrochemically oxidized Ti6Al4V alloy, an increase in the values of the polarization resistance is observed with the increase of the immersion time as compared with the untreated titanium alloy surface.

Keywords: electrochemical oxidation, titanium implant alloy, surface

XRD and SEM-EDX Investigations of the Low-Alloy Steels BVDH36 and LRAH36 Before and After Corrosion Tests

Adrian MAZILU[1], Lidia BENEA[1]*, Vasile BASLIU[2]

[1] Competences Centre: Interfaces-Tribocorrosion-Electrochemical Systems (CC-ITES), Dunarea de Jos University of Galati, 47 Domneasca Street, RO-800008 Galati, Romania
[2] Cross-Border Faculty, Dunarea de Jos University of Galati, 47 Domneasca Street, RO-800008 Galati, Romania

*lidia.benea@ugal.ro

Abstract. The evaluation of the corrosion resistance of different types of materials remains a major priority in several industries to prevent catastrophic failures and accidents. The purpose of this study is to evaluate the corrosion resistance in natural sea water of two types of low alloyed carbon steels BVDH36 and LRAH36 by electrochemical methods. The electrochemical methods used are evolution of the free potential (OCP), electrochemical impedance spectroscopy (EIS), polarization resistance (R_p) and corrosion rate (V_{corr}), potentiodynamic poarization (PD) and cyclic voltammetry (CV). The studies are completed by ex-situ characterization analyzes of the studied surfaces before and after corrosion such as: optical microscopy, scanning electron microscopy and X-ray diffraction analysis. The results of the study show us that the polarization resistance of low-alloyed carbon steel BVDH36 is higher compared to the polarization resistance of low-alloyed carbon steel LRAH36. It is also observed that with the increase in the immersion time of the samples in natural seawater, the polarization resistance of the BVDH36 alloy increases over time and finally decreases, and for the carbon steel LRAH36 the polarization resistance increases.

Keywords: corrosion, sea environment, electrochemical impedance spectroscopy, polarization resistance, low-alloyed steel

Ecotoxicity Assessment of Geopolymerization Process Applied on Mine Mailing from Spain

Lyudmila ANGELOVA[1]*, Darya ILIEVA[1], Temenuzhka RADOIKOVA[1], Andriana SURLEVA[1]

[1]Department of Analytical Chemistry, Faculty of Chemical Technologies, University of Chemical Technology and Metallurgy, 8 'Kl. Ohridski blvd.',1756, Sofia, Bulgaria

*lyudmila@uctm.edu

Abstract. The mining and coal combustion industry produces a large number of mine tailings and fly ash byproducts. Most of them are classified as harmful to the environment but have a wide variety of applications. Raw materials recycling and their application in newly synthesized eco-friendly materials are the focus of scientists. In this regard, geopolymer technology is applied as an innovative approach. In the RecMine project, mine tailings and fly ashes from different sources are studied as byproducts for geopolymers production. A series of chemical and physicochemical characteristics of the raw materials are studied also as the obtained new materials. The potential mobility of Cd, Cr, Cu, Zn, Pb, and Ni in different media is evaluated, by applying a BCR sequential extraction procedure. Moreover, heavy metals mobility factor and individual and global contamination factors were calculated.

Keywords: BCR, mobility factor, level of encapsulation, raw materials

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High Milling Time Influence on the Phase Stability and Electrical Properties of $Fe_{50}Mn_{35}Sn_{15}$ Heusler Alloy Obtained by Mechanical Alloying

Florin POPA[1*], Traian Florin MARINCA[1],
Bogdan Viorel NEAMȚU, Ionel CHICINAȘ[1]

[1]Materials Science and Engineering Department, Technical University of Cluj-Napoca, 103-105 Muncii Avenue, 400641 Cluj-Napoca, Romania

[*]florin.popa@stm.utcluj.ro

Abstract. $Fe_{50}Mn_{35}Sn_{15}$ Heusler alloy was obtained by mechanical alloying after 30h of milling. To study the evolution of the phase stability during prolonged milling time, the milling was continued up to 50 h. The phases obtained by milling were analyzed by X-ray diffraction and it was found that the alloy crystallizes in a DO_{19} structure [1]. The stability and purity of the phase was studied for large milling times and using the Rietveld refinement, structural parameters, mean crystallite size and internal stresses amount were determined. The nature of the obtained phases by milling was found to be nanocrystalline. The morphological and elemental distribution was characterized by Scanning Electron Microscopy and Energy Dispersive X-ray Spectroscopy, with the evidence of phase separation and Fe contamination by milling media. As the milling time is increasing, the morphology of the sample was found to change. Influence of the present phases to magnetic properties was measured. Electrical resistivity evolution with milling time and temperature was analyzed and the electrical character of the powder was described.

Keywords: Heusler alloys, mechanical milling, nanocrystalline, electrical resistivity

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Copper Deposits Obtained by Arc Spraying Process - with Antibacterial and Corrosion Resistant Properties

Edmond LEVARDĂ[1], Codrin-Dumitru CÎRLAN[1], Marius PETCU[1]*, Stefan Lucian TOMA[1]

[1]"Gheorghe Asachi" Technical University of Iasi, Materials Engineering and Industrial Safety Department, No. 67 Prof. D. Mangeron Blvd., 700050, Iasi, Romania

*marius.petcu@student.tuiasi.ro

Abstract. This work describes the morphology, corrosion resistance, and antibacterial performance of copper coating deposited onto carbon steel by arc spraying process (ASP). Cross-sectional images of the coating showed a dense microstructure, with porosity lower than 4%. XRD analysys revealed no oxides or phases different to pure copper. The results of electrochemical tests demonstrated the efficient barrier properties and the compact microstructure of the coating, which protected the substrate against corrosion in chloride solution for >1000 h. The copper coating was effective as an antimicrobial agent for inhibiting the growth of *Staphylococcus aureus*, with bacterial growth being completely inhibited after 10 min of direct contact between the bacteria and the coating surface.

Keywords: antibacterial performance, arc spraying process

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Innovative Experimental Testing Program of Direct Shear Test in Soil Mechanics

Mircea ANICULAESI[1], Zakaria OWUSU-YEBOAH[1], Andreea Vasilica DASCALU[1], Iancu Bogdan TEODORU[1], Irina LUNGU[1*]

[1]Faculty of Civil Engineering and Building Services, Gheorghe Asachi Technical University of Iasi, 67 Prof. D. Mangeron Blvd, RO-700050 Iasi, Romania

[*]irina.lungu@academic.tuiasi.ro

Abstract. The research work aims at analyzing for the first time the data set obtained on cohesive soil samples following the publication of the Romanian Invention Patent RO 134239 [1]. The standard test method for the direct shear test provides the shear strength parameter – internal friction angle in consolidated drained condition - of either undisturbed or remoulded soil samples forcing the shear plan at the midsection of the sample in the horizontal direction. The samples are provided in paralelipipedic shape (6 cm x 6 cm x 2 cm) and the displacement rate in horizontal direction is 0.1 mm/min. The new equipment patented in Romania change the direction of shearing, from horizontal to vertical, and the soil samples are of cubic shape with 6 cm each side. The tests that have been made followed the same displacement rate of 0.1mm/min, this time along the vertical direction. The results from both, standard and new, testing programs for peak and residual shear strength are compared and discussed in correlation to their potential usage in the design of the man made slopes or stability analyses of natural slopes. The innovative testing program opens the possibility to allow for a variability of the shear strength parameters to be used along the soil failure surface developed in both natural and compacted soil structure where the water table divides the soil condition in drained and undrained state.

Keywords: direct shear test, shear strength parameters, soil mechanics

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A Green Biotechnology to Prevent Harmful Algae Blooms in Freshwater Lakes

Vasile Daniel GHERMAN[1], Vily Marius CIMPOIASU[2], Ioana Corina MOGA[3], Radu POPA[4*]

[1]University Politehnica of Timisoara, Faculty of Civil Engineering, Department of Hydrotechnics, Spiru Haret Street, RO300023, Timisoara, Romania
[2]University of Craiova, Faculty of Horticulture, Biology and Environmental Engineering Department, A.I. Cuza Street, no 13, RO 200585, Craiova, Romania
[3]DFR Systems S.R.L., Drumul Taberei Street, no 48, Bl. G2/3, Ap. 2, Sector 6, Bucharest, Romania
[4]River Road Research, 2440 Sheridan Dr., Tonawanda, NY, 14150

[*]radu.o.popa@gmail.com

Abstract. Due to pollution with fertilizers and warmer climate, an increasing number of lacustrine environments worldwide are at elevated risk of algal blooms. In most severe cases, Harmful Algae Blooms (HABs) produce toxic water and limit water usage for drinking, irrigation, aquaculture, fishing, and tourism. HABs also produce catastrophic damages to ecosystems such as dead zones and kill fish, invertebrates, birds and mammals that may need years to recover. Excess of nitrogen and phosphorus (N&P) is a leading cause of HABs, which occur in hypertrophic water bodies. Mitigating HABs is difficult and attempted by reducing emissions, by altering the hydrodynamic conditions or by removing or immobilizing excess nutrients. For example, P-reduction to reach larger than Redfield N:P ratio can decrease the severity of algal blooms. Yet, P-removal alone is not an ecosystem restorative solution to the broader eutrophy pollution problem. Biomass removal methods can help ecosystem restoration efforts, but only if the cost of N&P-removal can be kept low. The solution proposed by the authors is to use a phyco-remediation method; growth-and-harvest algae biomass to remove excess N&P from hypertrophic water bodies.

Keywords: phyco-remediation, Harmful Algae Blooms, nitrogen, phosphorus, hypertrophic water bodies

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Influence of Temperature on Properties of the Carboxymethyl Cellulose Quenching Environment

Manuela-Cristina PERJU[1], Elena-Luiza EPURE[2], Carmen NEJNERU[1], Ramona CIMPOESU[3*], Petrica VIZUREANU[1], Andrei Victor SANDU[1]

[1]Department of Technologies and Equipments for Materials Processing, Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University from Iasi, 700050 Iasi, Romania
[2]Department of Natural and Synthetic Polymers,"Cristofor Simionescu" Faculty of Chemical Engineering and Environmental Protection, "Gheorghe Asachi" Technical University of Iasi, 700050 Iasi, Romania
[3]Department of Materials Science, Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University from Iasi, 700050 Iasi, Romania

[*]ramona.cimpoesu@tuiasi.ro

Abstract. The carboxymethyl cellulose (CMC) dissolved in water in a percentage between 1 and 5 is used with good results for cooling of cast iron parts with ferritic-pearlitic matrix. The moderate cooling rate of this medium allows the structural transformation of austenite into martensite, but does not favour the increase of structural and thermal stresses dangerous for the integrity of the treated parts. The initial temperature of the quenching environment is an essential component for a correct heating result. In the paper the weldability characteristics of the solution at 20ºC, 30ºC, 40ºC, 50ºC, 60ºC are studied, as well as the corrosion characteristics at the same temperatures for ferritic-pearlitic nodular cast iron samples. The effect of temperature on the surface properties (water contact angle and corrosion) was investigated. Cyclic and linear voltametry was carried out at the mentioned temperatures and SEM photographs and EDX analyses were made of nodular graphite cast iron samples corroded in 2% CMC solution in water.

Keywords: carboxymethyl cellulose, pitting corrosion, wettability, heat transfer coefficient

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Improvement of Corrosion and Wear Behaviour of Nab Marine Propeller Based on Superalloy Laser Cladding

George Ciprian IATAN[1*], George ARDELEAN[1], Edit MOLDOVAN[1], Dan Cristian CUCULEA[1], Elena Manuela STANCIU[1], Alexandru PASCU[1]

[1]Materials Engineering and Welding Department, Transilvania University of Brasov, Eroilor Blvd., 29, 500036 Brasov, Romania

*george.iatan@unitbv.ro

Abstract. The aggressive operational conditions experienced by marine vessels are described by increased stress and strains along with harsh corrosion effect. In the above context, the marine propellers are exposed to various vulnerabilities that could lead to failure and compromise the ship's seaworthiness. The research endeavors to mitigate the corrosion and wear processes by extending the operational thresholds of nickel aluminum bronze (NAB) cast propellers. This sudy addresses to advanced laser cladding technologies in order to enhance the tribological and mechanical characteristics of NAB marine propeller. As it has been reported that the performance of copper alloy components can be expanded with laser cladding of Ni-based coatings [1], Trumpf TruPulse 556 pulsed wave laser and the Precitec WC 50 cladding module are used in order to obtain a corrosive resistant coating deposition on NAB marine propellers, by using METCO 58NS: Cu 36Ni 5 In alloy-based powder. The process parameter influence upon the coated geometry within the extended reflectivity of the copper matrix has been analyzed. The obtained coating exerts an enhanced corrosion resistance, while the microhardness of the coating is described by a slightly lower value than the base material.

Keywords: laser cladding, corrosion, nickel-copper coatings, microstructure

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Experimental Research on Laser Cladding with Pulsed Laser and Ni-Based Powder

Dan Cristian CUCULEA[1]*, George Ciprian IATAN[1], George ARDELEAN[1]

[1]Materials Engineering and Welding Department, Transilvania University of Brasov, Eroilor Blvd., 29, 500036 Brasov, Romania

*dan.cuculea@unitbv.ro

Abstract.The laser cladding process is a technological technique in which the laser radiation is utilised as thermal source and a metallic powder is melted and forms a layer for improvement of the surface of base material or creating a new surface [1]. This study aims at obtaining a data base in order to minimize the preparation time before actual research. Therefore, have been made experimental laser cladding tests on different common steels to be able to obtain a correlation between the process parameters and the results. The experimental set-up was formed of: Trumph TruPulse 556 pulsed laser generator and the Precitec WC 50 cladding module.

Keywords: laser cladding, Ni-based powder, pulsed laser

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.

SECTION 3

MATERIALS APPLICATION

Influence of Acceptor Materials in Ternary Organic Thin Films Used in Photovoltaic Applications

Anda OAJDEA[1], Laura HROSTEA[2*]

[1]Faculty of Physics, Alexandru Ioan Cuza University of Iasi,11 bd. Carol I, 700506 Iasi, Romania

[2]Research Center on Advanced Materials and Technologies (RAMTECH), Department of Exact and Natural Sciences, Institute of Interdisciplinary Research, Alexandru Ioan Cuza University of Iasi,11 bd. Carol I, 700506 Iasi, Romania

[*]laura.hrostea@uaic.ro

Abstract. In the pursuit of advancing the field of organic photovoltaics, this study delves into the optimization of ternary organic solar cells (TOSCs) by exploring various material combinations and processing conditions. Aiming to elevate both the efficiency and stability of TOSCs, we have investigated the interplay between PBDB-T-2Cl, ITIC-F, and PCBM within the active layer of the devices. Our approach encompasses empirical methods such as charge carrier mobility assessment, AFM surface morphology analysis, and electrical stability testing through electric measurements, to identify the most conducive morphologies and charge transport dynamics for enhanced solar energy conversion. Through meticulous temperature control and comparative assessment, key factors influencing photovoltaic performance were identified, including the impact of fullerene and non-fullerene acceptors on charge mobility and surface morphology. Our findings underscore the importance of acceptor material selection, along with their ratios to the donor polymer, in optimizing the efficiency and thermal behavior of TOSCs.

Keywords: ternary organic thin films, CELIV methods, electrical mobility

Acknowledgments: This work was supported by a grant of the "Alexandru Ioan Cuza" University of Iasi, within the Research Grants program, Grant UAIC, code GI-UAIC-2021-07.

Data acquisition System for a Hydroelectric Turbine Located Linearly on The Course of Flowing Water

Adrian BOGORIN-PREDESCU[1], Ștefan ȚÎȚU[2,3], Aurel Mihail ȚÎȚU[4]*, Marcin NABIAŁEK[5]

[1]National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independenței, București, Romania
[2]Iuliu Hațieganu University of Medicine and Pharmacy, 8 Victor Babes Street, Cluj Napoca, Romania
[3]The Oncology Institute "Prof dr Ion Chiricuță" Cluj Napoca, 34-36 Republicii Street, Cluj-Napoca, Romania
[4]Lucian Blaga University of Sibiu, 10 Victoriei Street, Sibiu, Romania
[5]Częstochowa University of Technology, Department of Physics, Armii Krajowej 19 Av., 42-200 Częstochowa, Poland

*mihail.titu@ulbsibiu.ro

Abstract. The present paper presents a system for remote monitoring of the hydrodynamic and electrical parameters of the water course of a hydroelectric generator operating in a linear and floating mode. Remote data transmission was selected as the preferred method due to the inability to directly measure the turbine elements as a complete unit. The resulting information is displayed on a computer monitor, allowing for timely decision-making when necessary. Efficient bidirectional data transmission is facilitated by a request/response communication protocol operating in half duplex mode. The authors provide a comprehensive account of the research methodology, research findings, and final conclusions derived from the experimental data, along with the unique contributions produced through this applied research.

Keywords: embedded systems, telemetry, communication protocol, hydroelectric turbine, hardware

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Investigating Lathe Tools in the Non-Metallic Materials Industry

Mădălina Simona BĂLȚATU[1*], Petrică VIZUREANU[1,2*], Andrei Victor SANDU[1,3], Iustinian BĂLȚATU[4]

[1]Gheorghe Asachi" Technical University of Iasi-Romania, Faculty of Materials Science and Engineering, 41 Prof. D. Mangeron Blvd., 700050, Iasi, Romania
[2]Technical Sciences Academy of Romania, Dacia Blvd 26, 030167 Bucharest, Romania
[3]Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, 050094 Bucharest, Romania
[4] Dunarea de Jos University of Galati, Faculty of Engineering, Galati, Romania

[*]madalina-simona.baltatu@academic.tuiasi.ro

Abstract. In the industrial field, the efficiency and durability of equipment play an important role in ensuring an optimal and sustainable production flow. This is particularly relevant in the context of non-metallic materials manufacturing, where lathe tools are essential components of the production line, having a direct impact on the quality of the final product and operational efficiency. The paper focuses on advanced laboratory investigation methodologies specifically applied to analyze and optimize the performance of metal turning tools, essential in manufacturing processes. We will explore innovative and multidisciplinary techniques for evaluating these critical tools, starting with chemical composition analysis by spectrometry, which allows us to identify optimal materials for different manufacturing applications.

Keywords: lathe tools, non-metallic materials, spectrometry analysis, material composition

Acknowledgements: This work was supported by a TUIASI research contract no. 846/ 11.01.2024.

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Advanced Materials for Telescopic Poles: A Multidisciplinary Approach

Bogdan Andrei ROTARU[1], Petrica VIZUREANU[1,2*], Ioan Gabriel SANDU[1], Dragos Cristian ACHITEI[1], Georgeana CĂPĂȚÎNĂ[1], Andrei Victor SANDU[1,3], Manuela Cristina PERJU[1]

[1] Gheorghe Asachi Technical University of Iasi-Romania, Faculty of Materials Science and Engineering, 41 Prof. D. Mangeron Blvd., 700050, Iasi, Romania
[2] Technical Sciences Academy of Romania, Dacia Blvd 26, 030167 Bucharest, Romania
[3]Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, 050094 Bucharest, Romania

[*]peviz2002@yahoo.com

Abstract. Telescopic poles are essential tools for law enforcement, security personnel and other professions that require an effective means of defense and crowd control. However, the traditional materials used in the construction of telescopic poles can have some shortcomings in terms of weight, durability and maneuverability. Therefore, there is increased interest in identifying and using new and improved materials to improve the performance and functionality of telescopic poles. The purpose of this study is to explore and evaluate advanced materials for the construction of telescoping poles, using a multidisciplinary approach that combines research in materials science, mechanical engineering and practical performance testing. By integrating knowledge and skills from multiple fields, this study proposes to advance the development of improved telescopic walking sticks that provide a high level of performance and reliability for their users. Thus, the aim is to increase safety and effectiveness in the field of application of telescopic walking sticks.

Keywords: telescopic poles; composite materials; optimal characteristics

The Influence of Vibration Frequency on the Physical and Mechanical Properties of Pump Materials

Olga V. IVANOVA[1,2*], Vitaliy V. SAVINKIN[1,2*], Amandyk K. TULESHOV[1], Andrei Victor SANDU[3,4], Petrica VIZUREANU[3,5]

[1]Joldasbekov Institute of Mechanics and Engineering; 28, Shevchenko Str., Almaty, 050010, Kazakhstan
[2] Transport and Mechanical Engineering Department, M. Kozybaev North Kazakhstan University; 86, Pushkin Street., Petropavlovsk, 150000, Kazakhstan
[3] Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iaşi, Boulevard D. Mangeron, No. 51, 700050 Iasi, Romania
[4] Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, 050094 Bucharest, Romania
[5] Technical Sciences Academy of Romania, Dacia Blvd 26, 030167 Bucharest, Romania

*cavinkin7@mail.ru; itf.nkzu@mail.ru; sav@tuiasi.ro

Abstract. The article investigates the impact of vibration loads on the phase structure of the material and the durability of a centrifugal pump. The natural frequencies of the impeller (> 100 Hz) were found to be 75% higher than the structure's operating speed (25 Hz), indicating that the wheel structure is sufficiently rigid for the selected materials 12Cr7Mn3SiC. The novelty is represented by the established dependences of changes in the range of vibration frequencies, which lead to degradation of the physicomechanical properties of the material's phase structure due to dynamic loads of various vibration types. The significance is reflected in the systematization of structural and frequency-vibration factors that influence the formation of fatigue stress concentrations and the origin of microcracks in the phase structure of perlite.

Keywords: vibration frequencies, modeling, physical and mechanical properties, phase structure

Demonstrator – Electro - Metallurgical Metalothermal Converter

Tudor-Adrian COMAN[1], Mihai Ovidiu COJOCARU[1]

[1]Competences Centre: National University of Science and Technology POLITEHNICA Bucharest – Faculty of Materials Science and Engineering, Spl. Independentei 313 sector 6 Bucharest, Romania

quarkimpex2023@gmail.com

Abstract. The "metallothermic electro-metallurgical converter" (hereinafter - CE-MM) represents the main inventive subassembly that makes possible the construction of "metallothermal-thermal power plants" (hereinafter -TM), more efficient and cleaner than existing thermal power plants [1]. Similar (CE-MM) may represent a technical-scientific challenge for the refurbishment of existing power plants. Metallothermal power plant (TM) is a thermal power plant using "fuels metallothermal" to produce simultaneously, cleaner and more efficiently both electricity and metallurgical products (metals, alloys, corundum slags and reaction gases). "Metallothermic fuels" (hereinafter - COMB) are powdered, thermitic mixtures consisting of tinning (powdered oxide steel waste) and/or iron ores (pyrite or siderite free), metal reducers (e.g. Al powders), reaction moderators and alloying materials, dosed as a percentage and homogenized. Use (COMB) is a form of circular economy which, also using renewable energy resources, allows simultaneous obtaining of thermal energy and metallurgical products while reducing the production of polluting materials (e.g. $C0^2$, H^2S, $S0^2$, $S0^3$, NOx). Currently, many classical thermal power plants use polluting fuels (e.g. coal, fuel oil, natural gas, etc.) as their primary source of energy. This reality has led to the shutdown of some of the operational thermal power plants. Of course, if there were furnaces (boilers) capable of "burning" less polluting fuels, shutdown power plants could be restarted.

Keywords: unconventional thermoelectric energy, obtaining metallurgical products without using coke ovens, furnaces and cast-steel ovens

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Effect of Acoustic Waves Caused by Bells on a Stained-Glass Window

Dawid CEKUS[1*], Sebastian GARUS[1], Marcin NABIAŁEK[2], Maciej NADOLSKI[2], Piotr PASZTA[1]

[1]Faculty of Mechanical Engineering and Computer Science, Czestochowa University of Technology, al. Armii Krajowej 21, 42-201 Częstochowa, Poland
[2]Faculty of Production Engineering and Materials Technology, Czestochowa University of Technology, Armii Krajowej 19 Av., 42-200 Częstochowa, Poland

*dawid.cekus@pcz.pl

Abstract. The paper presents the influence of acoustic waves caused by bells on a stained-glass window and its components. The issue is particularly important in the context of church towers with bells and stained-glass windows. The research was divided into two parts. The first one concerned experimental and numerical studies of an example bell and the determination of its the acoustic properties (frequencies and corresponding values of the sound pressure level). In the second part, the free vibrations of a sample stained-glass window with changes related to the thickness of the glass used were analyzed numerically. By comparing the determined frequencies from both cases, it is possible to indicate resonance ranges that should be avoided. The showed results can be generalized to any other sources of acoustic waves and they can constitute the basis for determining the properties of the designed of stained-glass window or introducing additional barriers to avoid the phenomenon of resonance.

Keywords: acoustic waves, bells, stained glass window, natural frequency, FEM, SPL

Electrospunn Polymeric Fiber Systems Inoculated with Cyanoacrylate Tissue Adhesive: A Novel Hemostatic Alternative during Open Surgery

Victor TOSA[1*], Ilie-Ene ALEXANDRU[2], Septimiu TRIPON[3], Radu FECHETE[1], Amalia MEZAROS[1], Cătălin POPA[1]

[1]Materials Engineering Department, Technical University of Cluj-Napoca, 103-105 Muncii Ave., 400641, Cluj-Napoca, Romania
[2]Department of Surgery, Iuliu Hatieganu University of Medicine and Pharmacy,8 Victor Babes Street, 400012, Cluj-Napoca, Romania
[3]National Institute for Research and Development of Isotopic and Molecular Technologies, Cluj-Napoca, Romania

[*]tosavictor08@gmail.com

Abstract. Natural-based and synthetic tissue adhesives have attracted extensive attention in the last two decades due to their ability to stabilize uncontrolled bleeding instances. However, these materials present several drawbacks during exploitation that scientist have tried to minimize in order to optimize their usage. The aim of this study was the development of a novel wound dressing, combining the excellent properties of polylactic acid (PLA) and cyanoacrylate (CA) tissue adhesive, for rapid hemostatic action. Therefore, the fabrication of electrospun PLA substrates, the effect of process parameters upon their morphology, the design of the sport systems as well as their shelf life evolution are emphasized in this paper. Successful in vivo tests have been carried out on rat test subjects after successful fabrication of these wound dressings.

Keywords: electrospinning, polylactic acid, wound dressing, tissue adhesive

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Assessment of New TiO_2 Crystalline Structures Obtained by Electrochemical Methods on Titanium Alloys for Specific Medical Applications

Vasile BAȘLIU[1], Lidia BENEA[2]*

[1]Cross-Border Faculty, Dunarea de Jos University of Galati, 47 Domneasca Street, RO-800008 Galati, Romania
[2]Competences Centre: Interfaces-Tribocorrosion-Electrochemical Systems (CC-ITES), Faculty of Engineering, Dunarea de Jos University of Galati, 47 Domneasca Street, RO-800008 Galati, Romania

*lidia.benea@ugal.ro

Abstract. Among the ways of investigating and characterizing materials, in general, structural analysis comes and confirms a series of information related to the crystal structure of the phases present or newly formed as well as other specific details such as for example the size of the crystallites. This new information joins the other ways of characterizing material properties supporting the development of new crystalline structures for their contribution to the chosen purpose. Thus, the structural analysis was developed with the help of X-ray diffraction analysis (XRD) using the 3M DRON equipment provided by the university. Later, the diffractograms were processed using the software program Match! and the free Crystallography Open Database (COD).The application of the anodic oxidation mechanism to the Ti-alloy/TiO_2 electrochemical system under the conditions of an acidic environment was evaluated by varying the potential difference (electrical voltage) in a preset time.In the conditions shown above, the kinetics of the chemical reaction was activated, which resulted in the appearance and growth of a new distinct phase - the oxide layer itself, having a specific crystalline structure that was structurally analyzed. The newly formed oxide layer on titanium alloy can be considered a good candidate for medical applications.

Keywords: structural analysis, titanium oxide layer, medical applications

Novel Approach for Capillary Force Microfluidic Devices Designed for Medical Applications

Cătălin POPA[1*], Violeta MERIE[1], Victor TOŞA[1]

[1]Biomaterials Research Group, Department of Materials Science and Engineering, Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, 103-105 Muncii Str., 400641 Cluj-Napoca, Romania

[*]catalin.popa@stm.utcluj.ro

Abstract. The research work targets novel medical applications of Paper Microfluidics - type devices functioning through a synergic effect of capillary and field forces, such as the dielectrophoretic one. Cellulose – based membranes, as well as electrospun polylactic acid membranes were surface patterned in order to direct and contain the flow of analytes / biologic samples. In the case of polymer substrates, UV activation techniques were employed for inducing of a temporary hydrophilic effect. The as – conditioned membranes were inserted in custom – made devices that produce uneven electric felds aiming to induce dielectrophoretic forces upon polarizable particles in the flow. 3D constructs that use a spatial distribution of capillary forces were considered as well. The devices are designed in view of developing cheap medical applications for the separation of live cells, for studying the effect of antibiotics on bacterial biofilms or for bio – patterning of membranes to be used as active elements in medical MEMS.

Keywords: paper microfluidics, medical applications, capillary forces, dielectrophoretic effect, surface bio - patterning

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Renewable Resources for Bricks' Realization

Nicoleta Raluca JIANU[1], Gabriel POPESCU[2], Aneta CHIVOIU[1], Silvia MORARU[1], Mirela SIMION[1], Ioana Corina MOGA[2*]

[1]North Giurgiu Technological and Industrial Park, 351-352 Bucuresti Street, RO 080309, Giurgiu, Romania
[2]Center for Study and Research for AgroForestry Biodiversity "Acad. David Davidescu", Romanian Academy, 13 Calea 13 Septembrie Street, RO 050711, Bucharest, Romania

[*]corinamoga@yahoo.com

Abstract. The purpose of the research carried out by the authors is represented by the use of waste, such as that from agriculture, from wastewater treatment plants (WWTP) and from the fiber glass industry in order to obtain construction materials (bricks). The authors, as part of a research project, designed and tested new recipes for making bricks, starting from a series of existing waste materials in significant quantities. By using different types of waste and re-introducing them into the economic circuit, a better protection of the environment is ensured in the current context of climate change. Significant amounts of waste are generated by economic activity. In the framework of the research carried out by the authors, solutions were sought for the valorization of some wastes from agriculture, those from the industrial wastewater treatment and from constructions in order to make bricks. The receipt for bricks fabrications, proposed by the authors, contains the following materals: wastewater sludge, agricultural waste (corn cobs and sunflower stalks), cement, sand, glass fiber, clay. Bricks that can be used in non-structural constructions were obtained.

Keywords: brick, agricultural bioresources, construction materials

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Co-remediation of Refinery Oily Sludge with Food Waste Digestate

Muhammad Syahmi Najmi MAT ADNAN[1], Mohammad Anuar KAMARUDDIN[1*], Norazian Mohamed NOOR[2]

[1]Environmental Technology Division, School of Industrial Technology, Universiti Sains Malaysia
[2]Faculty of Civil Engineering & Technology, Universiti Malaysia Perlis (UniMAP), Perlis, Malaysia

[*]anuarkamaruddin@usm.my

Abstract. The refinery oily sludge poses a significant challenge due to its complex composition and adverse environmental impacts. Conventional remediation methods often involve high costs and generate secondary pollutants. This study investigates the potential of using food waste digestate which is produced through anaerobic digestion as a co-remediation agent for refinery oil sludge. This study characterizing the physicochemical properties of oil sludge and food waste digestate on pH, density, moisture content, ash content, and oil & grease levels. The identification of bacteria in food waste digestate by Gram staining method. The laboratory involves sample preparation, heat fixation, staining with crystal violet, iodine treatment, alcohol decolorization, and counterstaining with safranin. Following staining, bacterial cells are observed under a light microscope to determine Gram reaction, facilitating initial categorization into Gram-positive or Gram-negative groups. The hydrocarbon degradation was studied using gravimetric analysis. The experiment was performed in 150mL glass bottles containing modified Bushnell-Haas broth medium, nutrient broth, oily sludge, and food waste digestate. Then, the flask was incubated on rotary shaker at 160 rpm and 37ºC for 1,3,5,9, and 11 days. Germination test assay was conducted with added natural soil (150g) and each pot will plant with 6 seeds mung bean/ vigna radiata. This experiment is to determine the effect of different incubation times on seed germination in oily sludge and food waste digestate mixtures.

Keywords: refinery oily sludge, food waste digestate, anaerobic digestion.

Coating Properties of Smart Intermetallic Packaging Materials from Al_2O_3/ $FeAl_3$ Obtained by Spraying with Atmospheric Plasma. Applications in the Food Engineering

Steluța RADU[1], Stefan Lucian TOMA[2]*

[1]University of Life Sciences Iași, Romania
[2]Gheorghe Asachi" Technical University of Iasi, Materials Engineering and Industrial Safety Department, No. 67 Prof. D. Mangeron Blvd., 700050, Iasi, Romania

*stefan-lucian.toma@academic.tuiasi.ro

Abstract. Metal packaging is used for canned food, ensuring long-term preservation of food and mechanical protection, strength. There is a study about the search an aluminum alloys with good thermal resistance on structural stability at 350º. This chemical composition Al-Cu-Mg-Ni; Al-Cu-Mg-Ni-Mn-Cr can form technological alloys with good fluidity, which do not contain non-metallic inclusions especially Al_2O_3, and do not tend to form cracks and cracks, hot, because castings have complex geometric configurations and are poured into molds. The alloy has a tensile strength of 230-280N/mm^2. For testing alloys from polyinary groups Al+Cu+Mg+Ni and other alloying elements from transition groups such as Mn, Cr, Mo showed that: copper-rich alloys, and especially those of the Al-Cu-Ni system, possess greater refractoriness than binary alloys such as Al-Cu; Al-Si; Al-Mn and even Al-Ni. The alloy of complex chemical composition is more refractory both complex phases $Al_3(Cu,Ni)_2$ and phases containing Mn and Cr.

Keywords: properties of smart intermetallic packaging, Al-Cu-Mg-Ni.

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SECTION 4

MATERIALS & LIFE SCIENCE

Integrating Artificial Intelligence in Nanomaterials Science: Pathways to Revolutionary Materials Discovery and Design. Ethics and Risks

Alexandru-Silviu GOGA[1]

[1]University of Transylvania Brașov, Faculty of Technological Engineering and Industrial Management, Phd. Student in Artificial intelligence, Lawyer, Master of Laws, Esquire

*alexandru.goga@unitbv.ro

Abstract. The interdisciplinary nexus of artificial intelligence (AI) and nanomaterials science heralds a paradigm shift in materials discovery and application. This paper provides a comprehensive exploration of how AI is revolutionizing the field of nanotechnology, with a particular focus on the synthesis, characterization, and deployment of nanomaterials. We begin by defining nanomaterials and elucidating their unique, scale-dependent properties that make them integral to advancements in sectors such as health, electronics, and environmental science. Advancements in machine learning (ML) algorithms have unlocked unprecedented capabilities in predictive analytics, enabling the design of nanomaterials with tailored properties. We delve into the specifics of how ML and deep learning are employed to correlate nanomaterials' structural attributes with their functional characteristics, thus facilitating a more nuanced understanding of structure-property relationships. Furthermore, the paper examines AI's role in enhancing the resolution and interpretative power of characterization techniques like electron microscopy and spectroscopy. The conclusion encapsulates the synergistic potential of AI and nanotechnology, emphasizing the need for sustainable and responsible innovation. The future directions point towards an AI-integrated approach that is poised to redefine the landscape of material science and engineering.

Keywords: artificial intelligence, nanotechnology, ethics, risks, synthesis

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Methods for the Preservation and Restoration of Dunhuang Wall Paintings: Foreign Experience

Shiru WANG[1], Ion SANDU[2,3,4,5], Yulia IVASHKO[1], Michał KRUPA[6], Anna KRUKOWIECKA-BRZĘCZEK[6], Tetiana YEVDOKIMOVA[1], Serhii STAVROYANY[1], Oksana KRAVCHUK[1], Andrei Victor SANDU[2,7]

[1]Kyiv National University of Construction and Architecture, 31 Povitroflotskyi Avenue, Kyiv, 03037, Ukraine
[2]Academy of Romanian Scientists AOSR, 54 Splaiul Independentei St., Sect 5, 050094 Bucharest, Romania
[3]Alecsandru Ioan Cuza University of Iasi, Interdisciplinary Research Institute – Science Departament,
11 Carol I Bulevard, 700506 Iasi, Romania
[4]National Institute for Research and Development in Environmental Protection, 294 Splaiul Independentei,
Sector 6, 060031 Bucharest, Romania
[5]Romanian Inventors Forum, Sf. Petru Movila St., L11, 3-3, 700089 Iasi, Romania
[6] Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31-155, Cracow, Poland
[7]Gheorghe Asachi Technical University from Iași, 700050, Romania

*wangshiru923@163.com, sandu_i03@yahoo.com

Abstract. The fresco restoration methods used in China were defined and characterized: Frontier method for protection of wall coatings in China using poly acrylic acid-functional graphene $Ca(OH)_2$ Nanocomposites; the use of organic (acrylic polymers Parrot B-72 and AC33) and inorganic materials (lime water, barium hydroxide, alkaline earth silicate) as reinforcing materials for the protection and restoration of fresco wall paintings; a method of strengthening and protecting frescoes with nanomaterials based on graphene materials based on polyacrylic acid graphene / nano $Ca(OH)_2$, which are synthesized by the aqueous solution method; desalination and elimination of excessive moisture using a three-layer desalination pad and desalination plates with secondary desalination; modern diagnostic methods, such as X-ray fluorescence, X-ray diffraction, scanning electron microscop, confocal spectroscopy.

Keywords: preservation, restoration, Dunhuang wall paintings

Specific Issues of Conservation and Restoration of Libya Mosques (7th century – 1815)

Mohammed SULAYMAN[1] , Yulia IVASHKO[1], Somayeh AFSHARIAZAD[2], Andrii DMYTRENKO[3], Krystyna PAPRZYCA[4], Anna SAFRONOVA[5], Olena SAFRONOVA[1], Tetiana YEVDOKIMOVA[1]

[1]Kyiv National University of Construction and Architecture, 31 Povitroflotskyi Avenue, Kyiv, 03037, Ukraine
[2] Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31-155, Cracow, Poland
[3]National University "Yuri Kondratyuk Poltava Polytechnic", 24 Vitaliia Hrytsaienka Avenue, Poltava, 36011, Ukraine
[4]Academy of Silesia, 43 Rolna Street, 40-555, Katowice, Poland
[5] Western University of Timișoara in Timisoara, 4 Vasile Pârvan Boulevard, 300223 Timisoara, Romania

[*] s.afshariazad@gmail.com

Abstract. The characteristics of mosques in each region of Libya are defined: a) Western Libya (Tripoli region) – characterized by multiculturalism due to continuous wars and several systems of government at the beginning of the introduction of Islam and Ottoman rule for four centuries. Arab, Maghreb, and Ottoman architectural traditions will be combined; b) Eastern Libya (Cyrenaica province) – characterized by multiculturalism as a result of numerous conquests and invasions. Ottoman, Andalusian (Azhdabia, Benghazi, Derna), and local traditions are combined; c) South (Fezzan province) – characterized by regional uniqueness due to isolation from external influences due to desert natural and climatic conditions (Ghadames, Sabha, Aujila). The main element that expresses the Libyan national identity is found to be the small, symmetrical domes that distinguish the Libyan traditional mosque roof style from other neighboring countries and other Islamic countries.

Keywords: mosques, Libya, conservation, restoration

Preserving Authentic Decoration in the Entrance Spaces of Residential Buildings in Eastern Galicia from the Late 19th to the First Third of the 20th Century: Restoration Experience

Uliana SHCHEVIOVA[1]* Karol WYSZNACKI[2], Aleksander SERAFIN[2]

[1]Lviv National Academy of Arts 38 Kubiyovycha Street, Lviv, 79011, Ukraine
[2] Lodz University of Technology, Institute of Architecture and Urban Planning, 116 Zeromskiego Street, Lodz, 90-924, Poland

* uliana.shcheviova@gmail.com

Abstract. The vestibules and stairwell spaces of Secession-era buildings in Galicia are an important component of Ukraine's architectural heritage. As a result of the conducted research, three main types of entrance spaces were identified based on their layout (inside the volume or section; offset to the right or left relative to the main axis of the building; corner placement), and four groups of entrance spaces based on the presence of decoration were established:entrance space with paintings and artistic metalwork on stairs; entrance space with sculpting and artistic metalwork on stairs;entrance space with paintings, sculpting, and artistic metalwork on stairs; entrance space with paintings, sculpting, stained glass windows, and artistic metalwork on stairs.

Keywords: residential architecture; entrance spaces; preservation

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The Innovative Means of Physical Factors Indoor Normalization in Reconstructed and Restored Buildings and Structures

Valentyn GLYVA[1*], Larysa LEVCHENKO[2], Nataliia BURDEINA[1], Tetiana TKACHENKO[1], Grzegorz TWARDOWSKI[3], Yana BIRUK[1], Serhii ZOZULIA[4], Larysa ZOZULIA[4]

[1]Kyiv National University of Construction and Architecture, 31 Povitroflotskyi Avenue, Kyiv, 03037, Ukraine
[2] National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Peremohy ave., 37, Kyiv, 03056, Ukraine
[3] Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31-155, Cracow, Poland
[4]National Aviation University, Liubomyra Huzara ave., 1, Kyiv, 03058, Ukraine

[*]hlyva.va@knuba.edu.ua

Abstract. The problems of reconstruction and restoration of buildings and structures are relevant all over the world. It is especially important for Ukraine, where a large number of historical buildings and buildings of architectural value have been destroyed or damaged by military operations.The developed noise-protective composite materials based on foam latex and expanded polystyrene allow for high noise reduction indices in the entire sound range. A particularly important result is the reduction of low-frequency noise levels (by 12–30 dB), which is practically not absorbed by building materials and structures. The addition of 5–10 % magnetite to the mixture allows for simultaneous shielding of acoustic and electromagnetic fields. Studies have shown that LED ultraviolet radiation sources can be used in the presence of people for at least 8 hours without reaching the maximum permissible exposure level of 30 J/m^2 according to SBM-2015.

Keywords: historical building, reconstruction, electromagnetic field, noise

Aspects on Preserving Wall Paintings (Example of Ukraine and China)

Viktoriia ZAITSEVA[1,*], Andrei Victor SANDU[2,3,4,5], Vladyslav SMILKA[6], Bianca BOROS[7], Oleksandr IVASHKO[6], Tomasz KOZŁOWSKI[8], Yuliia KHARABORSKA[6], Lidiia SHEVCHENKO[6]

[1] National Preserve "Kyiv-Pechersk Lavra",Lavrska Street 9, 01015 Kyiv, Ukraine
[2]Academy of Romanian Scientists AOSR, 54 Splaiul Independentei St., Sect 5, Bucharest, 050094, Romania;
[3]Alexandru Ioan Cuza University of Iasi, Interdisciplinary Research Institute - Science Department,
11 Carol I Boulevard, Iasi, 700506, Romania
[4]National Institute for Research and Development in Environmental Protection, 294 Splaiul Independentei,4 Sector 6, Bucharest, 060031, Romania
[5]Romanian Inventors Forum, Sf. Petru Movila Street, L11, 3-3, Iasi, 700089, Romania
[6]Kyiv National University of Construction and Architecture, 31 Povitroflotskyi Avenue, Kyiv, 03037, Ukraine
[7]"George Enescu" National University of Arts of Iasi, Faculty of Visual Arts and Design, 29 Cuza Vodă St., (Casa Balş), 700040 Iași, Romania
[8]Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31-155, Cracow, Poland

[*]vita_zaitseva@ukr.net

Abstract. The frescoes of the interior of the Trinity Gate Church were executed in the technique of oil painting (the main group of pigments: white lead, smalt, verdigris, orpiment, red lead, ochre, umber, ultramarine, indigo, cinnabar). A 2-3 cm thick plaster layer of the 16th–17th centuries was used as the basis for the painting, which contained identified lime with a filler and vegetable glue. The original painting, made with glue paints, can be dated to the beginning of the 17th century and needs additional research. Painting in the oil painting technique is done on a layer of oily soil containing red lead. As a result, it was established that the fact of the lack of timely restoration, "natural aging" of materials, aggressive environment, anthropogenic and technogenic factors led to the occurrence of negative processes in the state of conservation of paintings.

Keywords: conservation issues, murals, Ukraine, China, trinity gate

Questions on the Object's Authenticity in Ukraine's Restoration Sector

Nataliia KOVTIUKH[1,2*], Marek PABICH[3],
Vitaliy MOLOCHKO[1], Tomasz GRZELAKOWSKI[3],
Joanna MATUSZEWSKA[3]

[1]Kyiv Scientific Research Institute of Forensic Expertise, 6 Simia Brodskykh Street, Kyiv, 03057, Ukraine
[2]Kyiv National University of Construction and Architecture, 31 Povitroflotskyi Avenue, Kyiv, 03037, Ukraine
[3]Lodz University of Technology, Institute of Architecture and Urban Planning, 116 Zeromskiego Street, Lodz, 90-924, Poland

n.kovtiukh@gmail.com

Abstract. The authors focused on an important aspect of the preservation and restoration industries – authentication of works of art, details and elements of architecture, as well as the importance of proving the dating of architectural objects and works of art. This issue has always been relevant for Ukraine, as well as for other countries, and it became even more relevant during the post-war reconstruction when 863 objects of cultural heritage were destroyed and damaged in the period from 24.02.2022 to 25.11.2023. The existing experience of the "Ukrrestavratsiia" corporation in the field of authentication and dating of architectural monuments, decorative elements, and works of art was analysed. The procedure for establishing the dating and authenticity of works of art is described in specific examples

Keywords: authenticity, restoration industry, Ukraine, authentication

The Destruction of the Established Urban Environment of Borodianka and Irpen as a Result of the Russian-Ukrainian War

Yulia IVASHKO[1,*], Andrii DMYTRENKO[2], Oleksandr MOLODID[1], Oleksandr IVASHKO[1], Vitaliy MOLOCHKO[1], Serhii BELINSKYI[3], Przemysław BIGAJ[4]

[1]Kyiv National University of Construction and Architecture, 31 Povitroflotskyi Avenue, Kyiv, 03037, Ukraine
[2]National University "Yuri Kondratyuk Poltava Polytechnic", 24 Vitaliia Hrytsaienka Avenue, Poltava, 36011, Ukraine
[3] Knights of the Winter Campaign 28th Separate Mechanized Brigade, Armed Forces of Ukraine
[4]Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31-155, Cracow, Poland

[*] yulia-ivashko@ukr.net

Abstract. Although the Russian-Ukrainian war is still going on, calculations of the losses of cultural heritage objects, historical environment, residential and industrial stock, etc. are already underway. It was established that the degree of damage directly depended on the type of weapon used (explosive projectile or aerial bomb).The events of the Russian-Ukrainian war exacerbated the need to collect information on the state of preservation of cultural heritage monuments of national and local importance, destruction, or damage (except for the destruction or damage of monuments due to the military aggression of the Russian Federation). The issue of the geo-informative resource of the State Register of Immovable Monuments of Cultural Heritage was also raised.

Keywords: destruction problem; Russian-Ukrainian war; Borodianka; Irpin; urban environment; transformation.

Potential Applications of Water-Energy-Food Nexus Concept through Preservation and Restoration of a Remarkable Site from Bulgarian Black Sea Coast

Kristina GARTSIYANOVA[1], Stefan GENCHEV[2]

[1]National Institute of Geophysics, Geodesy and Geography, Hydrology and Water Management Research Center, Bulgarian Academy of Sciences (NIGGG-BAS), Sofia, Bulgaria, Acad. G. Bonchev Str., bl. 3, Sofia 1113, Bulgaria.
[2]National Institute of Geophysics, Geodesy and Geography, Department of Geography, Bulgarian Academy of Sciences (NIGGG-BAS), Sofia, Bulgaria, Acad. G. Bonchev Str., bl. 3, Sofia 1113, Bulgaria.

*krisimar1979@gmail.com

Abstract. The Water-Energy-Food (WEF) concept is focused on the balanced management of these highly interconnected resources. It strongly emphasis on cross-sectoral and multi-level interactions, as well as resource interdependence, by highlighting the link between the extraction and use of water, energy and food. The main goal of this article is the disclosure and argumentation of a potential local area (the northern part of the Bulgarian Black Sea coast) for applying the Nexus approach in the context of the Water-Energy-Food tripartite nexus. In the study area, there are three main components creating the conceptual framework of the Nexus approach (the lighthouse of cape Shabla, the late antique fortress of Karia and the possibilities of using the energy from the sea waves with the supporting functions of the Shabla sea flyover). The methods of field studies, scientific analysis and synthesis, as well as geographic information systems (GIS) are applied.

Keywords: Water-Energy-Food (WEF) concept, preservation and restoration, Bulgarian Black Sea coast.

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The Analysis and The Optimization of an Autonomous Mobile Platform Equipped with a Manipulator Arm for Sample Retrieval in Rough Terrain

Aurel Mihail TITU[1]*, Daniel BÂLC[2], Alina Bianca Pop[3], Adrian BOGORIN-PREDESCU[4], Stefan TITU[5,6]*, Marcin NABIAŁEK[7]

[1]Lucian Blaga University of Sibiu, 10 Victoriei Street, Sibiu, Romania
[2]National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independenței, București, Romania
[3]Technical University of Cluj-Napoca, Northern University Centre of Baia Mare, 62A, Victor Babes Street, 430083, Baia Mare, Maramures, Romania,
[4]National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independenței, București, Romania
[5]Iuliu Hațieganu University of Medicine and Pharmacy, 8 Victor Babes Street, Cluj Napoca, Romania.
[6]The Oncology Institute "Prof dr Ion Chiricuță" Cluj Napoca, 34-36 Republicii Street, Cluj-Napoca, Romania.
[7]Częstochowa University of Technology, Department of Physics, Armii Krajowej 19 Av., 42-200 Częstochowa, Poland

*mihail.titu@ulbsibiu.ro

Abstract. The current study meticulously analyzes and optimizes an autonomous mobile platform designed to navigate and operate in challenging terrains. This platform isn't just a single-function tool; it's versatile, customizable, and applicable across various domains from scientific research to search and rescue missions, continuously improving with each iteration.

Keywords: autonomous mobile platform, manipulator arm, sample retrieval, data transmission, Arduino.

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Using Optimization Algorithms to Design Phononic Barriers Protecting Monuments or Building Facades

Sebastian GARUS[1*], Dawid CEKUS[1],
Katarzyna BŁOCH[2]

[1] Department of Mechanics and Fundamentals of Machinery Design, Faculty of MechanicalEngineering and Computer Science, Czestochowa University of Technology, Dąbrowskiego 73,42-201 Częstochowa, Poland.
[2] Department of Physics, Czestochowa University of Technology, Armii Krajowej 19 Av., 42-200 Częstochowa, Poland.

[*] sebastian.garus@pcz.pl

Abstract. The work compares the design of phononic structures using two types of optimization algorithms. Using the genetic algorithm and the simulated annealing algorithm, optimal layer distributions were obtained in which the phononic band gap phenomenon occurs. The mechanical wave propagating in the obtained structure, for the given frequency ranges, significantly reduces the transmitted energy, thanks to which the building facade or monument located behind the obtained barrier is exposed to much smaller vibrations, which significantly reduces damage related to long-term fatigue load. The mechanical wave propagation was modeled using the Transfer Matrix Method algorithm, and the proprietary objective function allows for the reduction of wave transmission with the simultaneous reduction of high transmission peaks with small half-widths.

Keywords: transfer matrix method, genetic algorithm, simulated annealing, acoustic filtering, phononic structures.

Improving Wild Anadromous Sturgeon Conservation Status: Innovative By-Pass Solution for Iron Gates in to Reconnect the Historical Migration Routes

György DEÁK[1,2], Isabela SADÎCA[1,3*], Georgeta TUDOR[1], Monica MATEI[1], Elena HOLBAN[1]

[1] National Institute for Research and Development in Environmental Protection Bucharest - Splaiul Independenței 294, District 6, Bucharest, Romania, 060031
[2] PhD Habil. associate within the Faculty of Biotechnical Systems Engineering, The National University of Science and Technology POLITEHNICA Bucharest – Splaiul Independenței 313, District 6, Buchares, Romania, 060042
[3]PhD student within the Faculty of Biotechnical Systems Engineering, The National University of Science and Technology POLITEHNICA Bucharest – Splaiul Independenței 313, District 6, Buchares, Romania, 060042

Abstract. The anadromous sturgeon species in the lower Danube are currently critically endangered, and based on the studies of the INCDPM expert team and the 2022 report of IUCN-SSG (Sturgeon Specialist Group) it appears that the future prospects of these populations are unfavourable. This situation occurs mainly as a result of anthropogenic impacts, especially due to intensive fishing, poaching and hydrotechnical constructions (e.g.: dams, immersed obstacles such as the bottom sill on Bala Branch). The dams interrupted the historical spawning migration routes of these species and the bottom sill can interrupt them in the future. In this context, INCDPM has elaborated an innovative by-pass solution for the Iron Gates I, based on the longterm monitoring of ultrasonically-tagged sturgeons from the Black Sea to the Iron Gates. This article presents the methodology developed by INCDPM in order to ensure the implementation of the innovative by-pass solution with minimal risk of unseccesful restoration of the historical migration routes. The study aims to present the specific migration conditions and the actual routes, which have been determined by over a decade of in-situ monitoring of ultrasonically-tagged specimens. Additionally, simulations of upstream migration will be conducted and GIS maps will be developed to present historical migratory routes, with consideration given to hydrodynamic conditions and climate change scenarios.

Keywords: sturgeon species, historical migration, innovative by-pass solution, anthropogenic impact, ichthyofauna monitoring, hydromorphodynamic monitoring, climate change.

Modeling The Influence of Soil and Meteorological Parameters on Carbon Dynamics for Conservation in Wetland Ecosystems

Monica MATEI[1], György DEÁK[1,2], Natalia ENACHE[1,3], Lucian LASLO[1], Elena HOLBAN[1], Madalina BOBOC[1]

[1] Department of Climate Change and Sustainable Development, National Institute for Research and Development in Environmental Protection (INCDPM), Bucharest 060031, Romania.
[2] PhD Habil. associate within the Doctoral School of Biotechnical Systems Engineering, University POLITEHNICA of Bucharest, Romania
[3]PhD student, Doctoral School of Biotechnical Systems Engineering, University POLITEHNICA of Bucharest, Romania

Abstract. Wetlands are characterised by distinct hydrological regimes and have significant importance in the global carbon cycle, having the potential to reduce carbon emissions through long-term carbon storage in the soil. In this study, carbon dynamics were simulated using a process-based model DeNitrification-DeComposition (DNDC), for two locations along Dâmbovița River case study area. These scenarios took into consideration the interconnection of soil parameters, hydrology, meteorological conditions, and vegetation type. The findings showed that soil CO_2 emissions are positively and strongly correlated with air temperature and soil moisture, with changes in the water content of the soil regime having the greatest impact on CO_2 fluxes. Also, the model simulations have been calibrated and validated by statistical analysis of uncertainties with the values of CO_2 fluxes measured in situ using the dynamic closed chamber method. By comparing DNDC outputs with field measurements, the performance of the model was evaluated in different environmental conditions, and the results were consistent, which increased confidence in its application for assessing wetland ecosystems. These results contribute to a more comprehensive understanding of the carbon cycle in wetlands and an improved estimation of the effects of climate change on the dynamics of carbon in these ecosystems.

Keywords: DNDC, model evaluation, CO_2 fluxes, greenhouse gases, climate change

Mitigating Transboundary Water Pollution Arising from Armed Conflicts: A Multidisciplinary Assessment of the Black Sea and Coastal Area

György DEÁK[1], Alexandra HARABAGIU[1*], Florina-Diana GHEORGHE[1], Georgeta TUDOR[1], Isabela SADÎCA[1,2], Mădălina BOBOC[1]

[1] National Institute for Research and Development in Environmental Protection Bucharest - Splaiul Independenței 294, District 6, Bucharest, Romania, 060031
[2] Faculty of Biotechnical Systems Engineering, The National University of Science and Technology POLITEHNICA Bucharest – Splaiul Independenței 313, District 6, Buchares, Romania, 060042

*alex19hara@gmail.com

Abstract. The impact of armed conflicts can be direct, highlighted by population displacement and casualties, infrastructure destruction, together with social and economic hiatus, but also indirect determined by the movement of air, water and soil pollutants across regional and national borders. There are numerous possible contamination sources of the water bodies and aquatic ecosystems that may appear during armed conflicts, including projectile composition, use of chemical weapons, discharge of untreated wastewater due to damage to sewage lines or wastewater treatment plants, unregulated waste management (improper disposal of industrial, hospital and municipal waste), oil spills, and deliberate poisoning of water resources. Thus, a comprehensive study from a multidisciplinary perspective of the armed conflicts is a sine qua non condition. In accordance, in order to properly assess the effects of pollution in the study area (Black Sea and coastal area) and to establish further strategies that can hinder the impact, water samples from various points of interest were analyzed to determine the water quality of the aquatic ecosystem and to possibly identify contaminants in the analyzed water bodies.

Keywords: armed conflict; water pollution; environmental impact; atomic absorption spectroscopy

Assessment of Atmospheric Pressure Plasma Exposure on the Seeds Germination

Bianca TATARCAN[1], Ramona HUZUM[2], Marian BURDUCEA[3], Constantin LUNGOCI[4], Andrei Vasile NASTUTA[1*]

[1]Physics and Biophysics Education Research Laboratory, Faculty of Medical Bioengineering, "Grigore T. Popa" University of Medicine and Pharmacy Iasi, RO-700454 Iasi, Romania.
[2]Integrated Center of Environmental Science Studies in the North Eastern Region, Interdisciplinary Sciences Department, Interdisciplinary Research Institute, "Alexandru Ioan Cuza" University of Iași, RO-700505 Iasi, Romania.
[3]Research and Development Station for Aquaculture and Aquatic Ecology, "Alexandru Ioan Cuza" University of Iași, RO-700505 Iasi, Romania.
[4]Department of Plant Science, Iasi University of Life Sciences, RO-700490 Iasi, Romania.

[*]nastuta.andrei@umfiasi.ro

Abstract. The application of atmospheric pressure plasma to the treatment of seeds prior to planting is a technique that shows promise for contributing to the development of sustainable agriculture. The germination of wheat seeds (Triticum aestivum L.) is the subject of this investigation, and the purpose of this study is to analyze the effect of plasma treatment on wheat seeds. For the purpose of plasma ignition, helium and argon were utilized as working gases. The study of the species that were formed revealed the existence of nitrogen and oxygen reactive species. An analysis of the germination and growth of the plant over a period of 14 days (the wheat grass stage) was carried out. According to the findings of the biochemical study of wheat grass, the plasma-treated variations exhibited an increase in the chlorophyll content, as well as an increase in the flavonoid and polyphenol content.

Keywords: atmospheric pressure plasma, plasma technology, plasma agriculture, plasma&seeds, plasma activated water.

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Calculating the Carbon Footprint within the Field of Road Freight Transport: A Specific Aproach

Alexandra-Florina IAMANDII[1], Aurel Mihail ȚÎȚU[2]*, Marcin NABIAŁEK[3]

[1]National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independenței, Bucharest, Romania
[2]Lucian Blaga University of Sibiu, 10 Victoriei Street, Sibiu, Romania
[3]Częstochowa University of Technology, Department of Physics, Armii Krajowej 19 Av., 42-200 Częstochowa, Poland

*mihail.titu@ulbsibiu.ro

Abstract. Road freight transport is the most used means of transportation, due to convenience and adaptability. Therefore, this sector is predicted to continuously grow over the course of years. However, internal-combustion engines used in road freight transport are responsible for a high proportion of the total air pollution. Determining the carbon footprint for organisations that operate within this specific industry represents a necessity from both environmental and economic points of view. The purpose of this paper is to calculate the carbon footprint of a freight transport organisation and identify solutions that can be put into practice in order to decrease the level of CO_2 emissions.

Keywords: carbon footprint, road freight transport, internal-combustion engine, CO_2 emissions, air pollution.

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The Transition to Alternative Fuels in the Maritime Sector in the Context of Decarbonization. Opportunities and Constraints

Andreea-Maria MOLDOVEANU[1], Aurel Mihail ȚÎȚU[2]*

[1]National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independenței, Bucharest, Romania
[2]Lucian Blaga University of Sibiu, 10 Victoriei Street, Sibiu, Romania

*mihail.titu@ulbsibiu.ro

Abstract. Alternative fuels can facilitate the green transition of the maritime sector over time, but there are constraints regarding the production capacity for the existing demand and the need to re-engineer the ships. This paper aims to analyze the types of alternative fuels currently available compatible with the maritime sector and the advantages and disadvantages they come with as well as the forecast of their use over time.

Keywords: decarbonisation, maritime sector, carbon neutral fuels, marine fuels, alternative fuels, electro fuels, biofuels

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Certain Aspects of Research Work in the Restoration of the Kyiv Velodrome

Oleksandr MOLODID[1,*], Volodymyr SKOCHKO[1], Sergey BOGDAN[2] , Marek PABICH[3], Karol WYSZNACKI[3], Joanna BOROWCZYK[3]

[1] Kyiv National University of Construction and Architecture, 31 Povitroflotskyi Avenue, Kyiv, 03037, Ukraine
[2] LLC "Mapei Ukraine", 13 Yevhena Sverstiuka Street, 5th floor, Kyiv, 02002, Ukraine
[3]Lodz University of Technology, Institute of Architecture and Urban Planning, 116 Zeromskiego Street, Lodz, 90-924, Poland

*molodid2005@ukr.net

Abstract. Kyiv Velodrome is the oldest sports facility in Ukraine and one of the oldest in Europe. In 2016-2017, the restoration of its track, administrative building, construction of an underground parking lot, and reorganization of the adjacent territory were carried out. As part of the scientific and technical support, an examination of the velodrome track was carried out to determine all existing defects and damages, and as a result, recommendations for their elimination were provided. In particular, solutions have been developed to repair cracks and recommended measures are aimed at preventing their appearance in the future. Also, within the scope of research work, some experimental studies were carried out with the designed constructions of the bicycle track for their compliance with the technical documentation and to establish durability (in laboratory conditions). The article analyzes and researches the structural and technological solutions proposed in the project documentation for the restoration and arrangement of the bicycle track, providing solutions and recommendations that will ensure the necessary quality and the project's design life.

Keywords: repair; velodrome; velodrome track; restoration work

Assessment of conservation status of Petroleuciscus borysthenicus celensis from Gurban River, Romania by Identification of Parasites and Bacteria

Abdulhusein JAWDHARI[1,2,3] , Isabela SADÎCA[1,4*] , Monica MATEI[1,] Mădălina BOBOC[1], Elena HOLBAN[1], Lucian LASLO[1], Dan Florin MIHĂILESCU[2]

[1] National Institute for Research and Development in Environmental Protection, 294 Splaiul Independenței Str, 060031 Bucharest, Romania
[2] Faculty of Biology, University of Bucharest, 91-95 Splaiul Independenței Str., 050095 Bucharest, Romania
[3] Department of Animal Production Techniques, Almussib Technical Instated, Al-Furat Al-Awsat Technical University, Najaf Str., Najaf 54003, IRAQ;
[4] PhD student within the Faculty of Biotechnical Systems Engineering, The National University of Science and Technology POLITEHNICA Bucharest – Splaiul Independenței 313, District 6, Bucharest, Romania, 060042

*isabelaadica01@gmail.com

Abstract. The present research was conducted within the framework of a broader investigation with the objective of identifying freshwater parasites and bacteria on national territory, with the aim of gaining a deeper understanding of the relationships between parasites, hosts, and the environment, and to assess the potential detrimental effects of parasitic infestation on the conservation status of fish populations. Within this study, it was documented the first recordings of parasites Vorticella globularia and Epistylis sp. in the Romanian Petro-leuciscus borysthenicus celensis fish species. A total of 42 specimens were collected from the Gurban River to study their infestation status, focusing on the skin, gills, and fins. From the samples analyzed, 16 specimens presented signs of infestation with five distinct parasite species (Ichthyophthirius multifiliis, Dactylogyrus vastator, Trichodina acuta, Vorticella globularia and Epistylis sp) and four bacterial strains (Aeromonas veronii, Shewanella putrefaciens, Aeromona hydrophila, and Citrobacter freundii). The results indicate that the skin is the organ most severely impacted by parasites and bacteria, followed by the gills. The fins, on the other hand, are the least susceptible to infection.

Keywords: Petroleuciscus borysthenicus celensis; fish parasites; fish bacteria; freshwater species; freshwater conservation

Prediction of Fine Particulate Matter ($PM_{2.5}$) in the Urban Area of Terengganu City, Malaysia using Artificial Neural Network (ANN)

Samsuri ABDULLAH[1,2*], Amalina Abu MANSOR[2], Aimi Nursyahirah AHMAD[2], Mohammad Fakhratul Ridwan ZULKIFLI[1], Suriani Mat JUSOH[1], Marzuki ISMAIL[2]

[1]Faculty of Ocean Engineering Technology, Universiti Malaysia Terengganu, 21030, Kuala Nerus, Terengganu, Malaysia
[2]Institute of Tropical Biodiversity and Sustainable Development, Universiti Malaysia Terengganu, 21030, Kuala Nerus, Terengganu, Malaysia

[*]samsuri@umt.edu.my

Abstract. Fine particulate matter or $PM_{2.5}$ has been identified as the pollutant that dominated the Air Pollutant Index (API) in Terengganu, Malaysia. This kind of pollution poses the most risk to human health since it may accumulate in unhealthful amounts. In the study of air pollution, the prediction of $PM_{2.5}$ concentration plays an important role as the problem of atmospheric pollutants is not a simple matter of controlling the emission sources but instead depends on gaseous pollutants and meteorological factors. This research aims to determine the optimum Artificial Neural Network (ANN) prediction model for accurately predicting the $PM_{2.5}$ levels. On an hourly basis, data were collected through the year 2022, including $PM_{2.5}$, meteorological data such as wind speed, temperature, and relative humidity, and air pollutants such as coarse particulate matter (PM_{10}), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), and ozone (O_3). Using the 80:20 data division, and trial and error method, the best ANN model was executed as 8:15:1 architecture. The performance of a prediction model for $PM_{2.5}$ that uses ANN reveals RMSE ($\mu g/m^3$) values of 0.016, and 0.019 and an R^2 of 0.964, and 0.956 during training, and validation, respectively. Therefore, it has been shown that the nonlinear model is highly capable of realistically expressing the nonlinearity of $PM_{2.5}$ in the atmosphere without the need for any previous assumptions.

Keywords: air pollution, particulates, nonlinear, meteorological variables, Malaysia

Fruit Quality Assessment in Agriculture: Firmness and Disease Assessment Based on High Level Features Fusion of Acoustic Impulse and Piezoelectric sensors

Fathinul Syahir AHMAD SAAD[1], Muhammad Zunnurrainie ZULKIFLI[1], Muhamad Khairul ALI HASSAN[1], Sukhairi SUDIN[1], Muhammad Faiz Aiman MOHAMED ZAINI[1]

[1]Department of Mechatronic Engineering, Faculty of Electrical Engineering and Technology, Universiti Malaysia Perlis, 02600 Arau Perlis, Malaysia.

*fathinul@unimap.edu.my

Abstract. Employing a comprehensive methodology encompassing multiple modalities, this study ventures into the realm of non-destructive techniques to evaluate and determine the quality of Fruit. The inherent challenge lies in predicting the optimal postharvest quality across diverse cultivars, with a particular focus on addressing the firmness and disease that stealthily affects the fruit. The article presents the result of research in Firmness and Disease Assessment based on High Level Features Fusion of Acoustic Impulse and Piezoelectric sensors. Acoustic impulse techniques involve generating mechanical impulses and analyzing the fruit's response, while piezoelectric sensors measure mechanical properties by converting mechanical stress into electrical signals. Acoustic impulse methods offer simplicity, portability, and rapid assessments of fruit firmness, making them suitable for field applications. Conversely, piezoelectric sensors provide precise measurements of mechanical properties and can detect subtle changes in fruit texture. Furthermore, both techniques offer potential for disease detection. Acoustic impulse devices can identify alterations in acoustic properties caused by diseases, while piezoelectric sensors may detect changes in mechanical properties induced by pathogenic infections. To get high accuracy for Firmness Measurement and Disease Detection, the high level data fusion was proposed. This method combined the features from Acoustic Impulse and Piezoelectric sensors and be able to achieve high accuracy classification.

Keywords: acoustic impulse, piezoelectric, fruit quality assessment, high level fusion

Study on Water Quality at Sungai Batu Feringghi, Pulau Pinang by using Qual2K Modelling and GIS

Ong Jing HONG[1], Mohamad Anuar KAMARUDDIN[1*], Rasyidah ALROZI[2], Norazian Mohamed NOOR[2]

[1]School of Industrial Technology, Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia
[2]Chemical Engineering Studies, College of Engineering, UiTM Cawangan Pulau Pinang, 13500 Permatang Pauh, Pulau Pinang, Malaysia
[3]Faculty of Civil Engineering & Technology, Universiti Malaysia Perlis (UniMAP), Perlis, Malaysia.

[*]anuarkamaruddin@usm.my

Abstract. Downstream of Sungai Batu Ferringhi is connected to the popular tourism spot of Batu Ferringhi Beach. The water quality deterioration in Sungai Batu Ferringhi directly affects the seawater quality, subsequently impacting fisheries and tourism activities. This study aims to identify both point and diffuse pollution sources in Sungai Batu Ferringhi and simulate water quality during normal flow and low flow events using QUAL2K. Concentrations of biochemical oxygen demand (BOD), ammoniacal nitrogen (NH3-N), total suspended solids (TSS), and total phosphorus are the focal water quality parameters. 6 water quality stations and 2 point sources were identified, and samples were collected from each. As per the National Water Quality Standards (NWQS), Sungai Batu Ferringhi falls under Class III. The baseline model was initially simulated and calibrated using a trial-and-error method. A 7Q10 low flow event was simulated by modifying water flow. During both normal flow and 7Q10 low flow events, most upper and middle stream sections of Sungai Batu Ferringhi met Class III standards, except for total phosphorus concentration. However, certain water quality parameters like BOD and total phosphorus failed to meet Class III standards, particularly in the middle and lower stream sections during both flow scenarios. A noticeable increase in BOD and total phosphate concentrations in the middle stream during low flow events impacted the river's water quality. Both point sources had negligible impacts on Sungai Batu Ferringhi's water quality. Diffuse sources, potentially from forest runoff, urban runoff, and agricultural runoff, are identified as the primary contributors of pollutants to Sungai Batu Ferringhi.

Keywords: water quality, Qual2K, nutrient, GIS, NWQS.

Intelligent Automated Garage System

Ryan HUANG[1], Yuan-Jung LAI[1*]

[1]Taiwan Math/ Science Circle, 2F., No. 390, Beitun Rd., Beitun Dist., Taichung City, Taiwan (R.O.C.)

*twmc.adm@Gmail.Com

Abstract. This paper introduces an automated garage designed to provide parking spaces for vehicles and to adjust the environment as needed. The main components include a garage body, a solar panel, a rainwater detector, a cooling fan, a ventilation window, and a controller. The system ensures that the parking space maintains optimal temperature and humidity for vehicle storage, enhancing the efficiency and longevity of the vehicle's mechanical components.

Keywords: automated garage, vehicle parking, environmental control, solar energy, cooling systems

1. Innovations in Vehicle Storage and Environmental Control Systems.
2. Impact of Environmental Control on Vehicle Maintenance.
3. Integration of Solar Energy in Modern Garages.
4. Advances in Real-Time Monitoring and Data Processing in Smart Garages.

Comprehensive Bed Structure for Continuous Monitoring

Yuan-Jung LAI [1], Yu-Chen LAI [1*]

[1]Taiwan Math/ Science Circle, 2F., No. 390, Beitun Rd., Beitun Dist., Taichung City, Taiwan (R.O.C.)

* Twmc.adm@gmail.com

Abstract. This paper presents a comprehensive bed structure designed for continuous monitoring, integrating various sensors and devices to track environmental parameters and physiological signals. The system includes a mattress body equipped with an alarm device, an environmental parameter detector, an emergency button, and a controller. Additionally, a pressure detector and a remote receiving device are incorporated to provide real-time data collection and monitoring. The design aims to enhance patient safety and comfort, particularly in healthcare settings.

Keywords: continuous monitoring, bed structure, environmental parameters, physiological signals, healthcare technology

1. Patent Application for Comprehensive Bed Structure for Continuous Monitoring.
2. Healthcare Technology Innovations in Continuous Monitoring Systems.
3. Impact of Continuous Monitoring on Patient Safety and Response Times.
4. Integration of Environmental and Physiological Sensors in Healthcare Devices.
5. Advances in Remote Monitoring and Data Transmission in Healthcare.

TiO_2 Nanomaterial Application for Removal Detergent Pollutants in Wastewater Treatment Plant Technology

Cristina Ileana COVALIU-MIERLĂ[1], Florinela PIRVU[1,2], Gigel PARASCHIV[1]

[1]University POLITEHNICA of Bucharest, 313 Splaiul Independentei Blvd., RO-060042, Bucharest, Romania
[2]National Research and Development Institute for Industrial Ecology – ECOIND, 57-73 Drumul Podu Dambovitei Street, RO-060652, Bucharest, Romania

* cristina_covaliu@yahoo.com

Abstract. Quaternary ammonium compounds (QACs) are key components in over 200 disinfectants recommended by the U.S. EPA for combating the SARS-CoV-2 virus. These compounds, which include benzalkyl dimethyl ammonium compounds (BACs), alkyl trimethyl ammonium compounds, and dialkyl dimethyl ammonium compounds, were extensively used globally even before the pandemic. Benzalkonium chloride, a typical quaternary ammonium compound, functions as a cationic surfactant with antiseptic properties and is commonly found in pharmaceutical and cosmetic products due to its effectiveness against bacteria and fungi. This study investigated the potential degradation of benzalkonium chloride using TiO_2 nanomaterial as a photocatalyst, with degradation monitored under UV lamp irradiation. High-Performance Liquid Chromatography–Diode Array Detector (HPLC–DAD) was employed to measure benzalkonium chloride concentrations. The photocatalytic activity of TiO_2 was evaluated by examining the degradation of benzalkonium chloride and two other cationic surfactants, tetradecyl dimethyl benzyl ammonium chloride (C14-BAC) and hexadecyl dimethyl benzyl ammonium chloride (C16-BAC), under UV exposure. The TiO_2 film demonstrated high efficiency in degrading both C14-BAC (95.01%) and C16-BAC (97.66%) under the experimental conditions.

Keywords: quaternary ammonium compounds, wastewater treatment efficiency, TiO_2

Impact of COVID-19 Infection on Patients with Acute Myocardial Infarction Candidates for Coronary Artery Bypass Grafting

Razan AL NAMAT[1], Cristina DIMITRIU[1], Amin BAZYANI[1], Andrei TARUS[1], Alberto BACUSCA[1], Grigore TINICA[1]

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

* dr.razan_romania@yahoo.com

Abstract. QDuring the COVID-19 pandemic, acute myocardial infarction was more common and more challenging to treat. In this paper, 12 cases of patients diagnosed with both ST elevation myocardial infarction (STEMI) and COVID-19 during 2021-2022 are presented, grouped based on COVID-19 severity. Psycho-emotional status was assessed using the Hamilton Depression and Anxiety Rating Scales (HAM-D and HAM-A). Patients with mild COVID-19 were mostly men, mean age 56.67±7.0, mean ejection fraction EF 47.17±5.12% on admission. Patients with more severe COVID-19 were 50% men, mean age 51.67±11.12, mean EF 35.00±15.17%. The latter also had significantly poorer oxygen saturation and required longer hospitalization. COVID-19 severity was in a strong, significant relationship with depression and anxiety scores. Patients with mild COVID-19 had a mean HAM-D score of 11.0, corresponding to mild depression, while patients with moderate to severe COVID-19 scored 17.17, which indicates moderate to severe depression (p=0.001). HAM-A scores averaged 18.67 for patients with mild COVID-19, suggesting mild anxiety, while HAM-A scores for patients with more severe COVID-19 averaged 25.0, indicative of moderate anxiety levels (p=0.001). These results highlight the psychological toll of concurrent life-threatening conditions such as myocardial infarction and infection with a new virus.

Keywords: myocardial infarction, COVID-19, depression, anxiety, Hamilton scales.


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Section 2: Procedures and Technologies for Materials Engineering


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