Book of Abstracts

EUROINVENT
ICIR 2025

International Conference on Innovative Research

May 8th to 9th, 2025
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)**
- **Romanian Society of Oral Rehabilitation**
- **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

XVIIth Edition, 8th - 10th May 2025

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 comprises the abstracts of the EUROINVENT International Conference on Innovative Research (ICIR) 2025. The ICIR Conference is held under the auspices of EUROINVENT, a comprehensive event dedicated to fostering creativity within a European framework by showcasing contributions from established academic institutions, higher education entities, as well as independent inventors and researchers.

The ICIR Conference serves as a distinguished platform for leading researchers, engineers, and scientists to present recent advancements and research findings in the field of Materials Science and Engineering. Its primary objective is to facilitate a high-level international forum for the dissemination and exchange of innovative ideas, techniques, and developments within the discipline.

This event encompasses a broad spectrum of topics in materials science, ranging from the synthesis and characterization of materials to engineering processes, technological innovations, applications, and interdisciplinary links to the life sciences. Each contribution has undergone a rigorous peer-review process by at least two experts in the respective subject areas, with selection based on scientific merit and relevance to the conference themes.

The editors hope that this volume will offer readers a comprehensive insight into current trends and emerging directions in materials science and engineering. It is intended to serve as a valuable reference for ongoing and future research endeavors.

We extend our sincere gratitude to all members of the ICIR 2025 Scientific and Organizing Committees for their outstanding dedication and effort. We also acknowledge the support of the publishers in facilitating the dissemination of the full articles. Finally, we express our heartfelt thanks to all contributing authors for their significant scholarly input to this volume.

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Program of EUROINVENT ICIR Conference
ORAL PRESENTATION

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

DAY 1 – THURSDAY MAY 08	
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 – Seiji YAMAGUCHI** *Bioactivity and Antibacterial Properties Imparted to Titanium Metal Through Surface Chemical Treatment: Development of Additively Manufactured Titanium Devices Contributing to Hard Tissue Regeneration*
12.45	**Keynote Speaker – Anton FICAI** *Drug Delivery Systems for Loco-Regional and Targeted Cancer Treatment*
13.15	***Snacks & Refreshments Break***
14.00	**Session 2** Chairman: Prof. Dr. Gultekin GOLLER Prof. Dr. Radu FIERASCU Prof. Dr. Andriana SURLEVA Prof. Dr. Iulian ANTONIAC
14.00	**Keynote Speaker – Joao NUNES-PEREIRA** *From Design to Application: Strategies for Developing Piezoresistive Composites for Structural Health Monitoring*
14.30	**Invited Speaker – Cristina-Ileana COVALIU-MIERLA** *Smart Materials for Wastewater Treatment Technologies*
15.00	**Alexandru BANARI** - *Sustainable Utilization of Agricultural Residues from Fruit Shrubs: Energy Potential and Physical-Chemical Properties*
15.15	**Jeevithan ELANGO** - *Hydrogel Coatings and Regeneration: Bridging Science and Healing*
15.30	**Alexandra-Florina IAMANDII, Aurel Mihail TITU** - *B Improving Environmental Quality by Taking Responsibility and Assessing GHG Emissions*
15.45	**Larisa POPESCU** - *Investigation of Mechanisms Leading to Early Aseptic Loosening of Hip Prostheses by Microscopical Techniques*
16.00	**Yulia IVASHKO** - *Problems of Repurposing the Monuments of Residential Architecture for Cultural and Artistic Function*
16.15	**Nicoleta Madalina STAN, Aurel Mihail TITU** - *Improving IT Projects by Using an Integrated Risk Management Model to Navigate Complexity*
16.30	**João PARENTE** - *Enhancing Fatigue Life in Hybrid Fiber Composites through Graphene Reinforcement*
16.45	**Dan-Cristian CUCULEA** - *Influence of Laser Pulse Design on Clad Layer Hardness and Geometrical Characteristics*
17.00	**Camilo ZAMORA-LEDEZMA** - *Biocompatibility Enhancement through Surface Modification of Metallic Biomaterials and Titanium Alloys*
17.15	**Daniel BALC, Aurel Mihail TITU** - *Contributions to Improving the Quality of a Mechatronic ABS Braking System Optimized through Dynamic Performance*
17.30	**Madalina Simona BALTATU** - *Novel Ti-Mo-Zr-Ta Alloys for Orthopedic Applications: Development, Characterization, and Performance Evaluation*
	Posters evaluation: 15:00 - 17:00
18.00	**End of Conference Day**

Program of EUROINVENT ICIR Conference
ORAL PRESENTATION

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

DAY 2 – FRIDAY MAY 09	
9.00	**Session 3** Chairman: Prof. Dr. Dimka FACHIKOVA Prof. Dr. Camilo ZAMORA-LEDEZMA Prof. Dr. Catalin POPA Prof. Dr. Seiji YAMAGUCHI
9.00	**Invited Speaker – Dewi Suriyani Che HALIN** *Microstructure Evolution of Ag/TiO2 thin film*
9.30	**Invited Speaker – Hasan GÖÇMEZ** *Boride Based Materials for Supercapacitor Electrodes*
10.00	**Invited Speaker – Rozyanty RAHMAN** *Polymer and Biocomposite Innovations: Advancing Sustainable Materials in Automotive Applications*
10.30	**Bogdan Viorel NEAMTU** - *Cold Sintered Fibres-based Soft Magnetic Composites*
10.45	**Ubon RERKAM** - *The Effect of Macconine on Lipid Accumulation in 3T3-L1 Preadipocytes and Molecular Docking on Pancreatic Lipase*
11.00	**Natalia ANFILOVA** - *Facial Recognition for a Vision-Activated Control System*
11.15	**Tatiana MALCOVA** - *Establishing and Managing Data in Biobank: Sharing Experience for Advancing Biomedical Research*
11.30	**Aurel TĂBĂCARU** - *Synthesis and Morpho-Structural Characterization of New Halogenosilane-Modified ZnO Nanoparticles*
11.45	**Florin POPA** - *Disordered Ni2MnxSn1-x off-Stoichiometric Heusler Alloy Formation with Low Sn Content by Mechanical Alloying*
12.00	**Mouna SELLAMI** - *The Effect of Ni, Cu and Cs Ions Incorporation on the Physico-Chemical Characterizations of Geopolymers*
12.15	**Norina FORNA** - *Surgical Techniques, Prosthetic Technologies, and Innovative Regenerative Materials in the Rehabilitation of Bone Structures for Prosthetic Restorations*
12.30	**Dumitru Doru BURDUHOS NERGIS** – *Freeze-Thaw Resistance of Geopolymer Composites with Waste Wood Addition*
	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
ORAL PRESENTATION

*Palace of Culture Iasi – **Henry Coanda Hall***

DAY 2 – FRIDAY MAY 09	
9.00	**Session 4** Chairman: Prof. Dr. Marcin NABIALEK Prof. Dr. Joao NUNES-PEREIRA Prof. Dr. Aurel Mihail TITU Prof. Dr. Bogdan Viorel NEAMTU
9.00	**Muhammad Mahyddin RAMLI** - *Multi-walled Carbon Nanotubes on Plastic for Nitrogen Dioxide Flexible Gas Sensor*
9.15	**Mihai Andrei PLATON** - *Investigation of the Thermogravimetric and Mechanical Behavior of a Novel Reinforced Composite Material*
9.30	**Oana-Roxana LAPUSAN (HANDABUT)** - *Studies and Research about Obtaining Natural Fiber-based Eco-materials*
9.45	**Dulexy SOLANO-ORRALA** - *In Vitro Evaluation of Antimicrobial Activity and Fibroblast Biocompatibility of Hydrogels Loaded with Cyclodextrin Inclusion Complexes of Non-Psychoactive Cannabinoids for Wound Healing Applications*
10.00	**George Ciprian IATAN** - *Optimization of Laser Cladding Technology in NAB Marine Propeller Reconditioning*
10.15	**Bianca Dumitrita TATARCAN** - *Plasma Exposure as Green Method to Enhance Surface Adhesion of Commercial Polymers for 3D Printing*
10.30	**Duarte F. MACEDO** - *Comparison of a Numerical 3D Simulation of the Elastic Modulus of Porous Bioceramics with Different Representative Volume Element Sizes*
10.45	**Traian Florin MARINCA** - *Soft Magnetic Composite Obtained from Nanosized Al-Permalloy and Hematite Nanoparticles by Reaction Spark Plasma Sintering*
11.00	**Monica MATEI** - *A Mini Review on Antibiotic Resistance Genes in the Environment*
11.15	**Natalia ENACHE** - *Assessment of Cropland CO_2 Emissions and Sustainable Land Use for Climate Change Mitigation*
11.30	**Claudia CRISAN** - *Using Organic Substaneces as Green Corrosion Inhibitors for Carbon Steel in HCl Solution*
11.45	**Natalia PAUL** - Magnetotactic Bacteria in the Medical Field versus Magnetic Nanoparticles
12.00	**Alina ROBU** - *Collagen-Hydroxyapatite Composite Wound Dressings Enhanced with Basil and Cinnamon Essential Oils*
12.15	**Olesea CAFTANATOV** - *From Leaves to Learning: an AR Journey into Home Plant Care*
12.30	**Diana-Petronela BURDUHOS-NERGIS** - *Tribological Characterization of Zn-Zr-Sr Conversion Coatings Deposited on Ti6Al4V*
	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 MAY 08	
	Poster Session 1 Chairman: Prof. Dr. Muhammad Mahyddin RAMLI Prof. Dr. Traian Florin MARINCA Prof. Dr. Ovidiu NEMES
P1.	**Oleksandr IVASHKO** - Repurposing the Monuments of Industrial Architecture into Modern Public Spaces of Art Direction
P2.	**Marta Ioana MOLDOVEANU** - Nuclear Magnetic Resonance in Tire Waste Mortars
P3.	**Madalina Elena NICORICI** - Accelerated Carbonation of Aggregates: A Sustainable Solution for Improving Mechanical Strength and Reducing the Carbon Footprint in the Construction Industry
P4.	**Gyorgy THALMAIER** - Floatable Syntactic Magnesium Foam as a Marangoni-Induced Propulsion Microboat
P5.	**Adriana ILEANA (BLAJAN)** - Technologies and Biomaterials for Manufacturing Surgical Guides Systems Used in Dental Implantology
P6.	**Cosmin NICOLESCU** - Analysis of the Mechanical Properties of Hardox Steel Coated with Different Materials
P7.	**Ana-Iulia BITA** - Corrosion Behavior of Mg–based Alloys for Medical Applications
P8.	**Elena PIEPTEA (POPESCU)** - Degradation Behavior of Various Magnesium Alloys in Simulated Body Fluids
P9.	**Ionela Luminita CANUTA (BUCUROIU)** - Innovations in Construction Materials Production and Usage for Carbon Neutrality - Ecological Education
P10.	**Iuliana CORNESCHI** - A Perspective Review of Applications of the Computed Tomography in Industry and Research
P11.	**Magdalena Gabriela HUTANU** - Analysis of the Influence of Torsional Deformation Characteristics on Seawater Corrosion Resistance of 316 Stainless Steels
P12.	**George COMAN** - Research on the Mechanism of the Corrosion Process of the Plate Corrosion of a Heat Exchanger from an Oil Refinery
P13.	**Nicoleta BOGATU** - Assessment the Efficiency of Green Corrosion Inhibitors for Steel Protection in Acidic Environment
P14.	**Daniela BURUIANA** - Study on the Formation and Properties of the Deposited Layer on a Metallic Material in a Simulated Natural Oral Environment
P15.	**Tiberiu Alexandru PIRVU** - Study on the Structure of Different Materials Used in the Manufacture of Medium-Caliber Ammunition
P16.	**Elena CIUTAC (NICOLAEV)** - Statistical Study on the Sustainable Management of Construction Waste in the Republic of Moldova
P17.	**Georgiana GHISMAN** - Innovative Coating Technologies for Enhanced Ballistic Material Performance
P18.	**Andrei IVANOV** - Nanostructured Materials for Enhanced Performance of Sensory Systems in Food Industry
P19.	**Catalin OPRITA** - Virtual Assistant for Fire Protection
P20.	**Beatrice TORAC TOMA** - A Virtual Assistant to Evaluate Pollution Levels in the Heat Treatment Sector
P21.	**Zakaria OWUSU-YEBOAH** - Innovations in One-Dimensional Consolidation Testing: A Review of the Double-Action Oedometer
P22.	**Dimka FACHIKOVA** - Corrosion Behavior of Mild Steel in Aqueous Solutions of Ammonium Nitrate
P23.	**Tsvetelina LIUBENOVA** - SEM and EDX Study of Zinc-Magnesium Phosphate Coatings on Mild Steel Surfaces
P24.	**Dimka FACHIKOVA** - Corrosion and Electrochemical Behavior of Advanced Titanium Alloys Suggested as Biomedical Materials
P25.	**Tina TASHEVA** - Structure and Optical Characteristics of Glasses in the TeO2-BaO-Bi2O3-B2O3 and GeO2-BaO-Bi2O3-B2O3 Systems
P26.	**Christian GIRGINOV** - Temperature-Dependent Microstructure and Properties of Porous Al2O3 Films
P27.	**Tina TASHEVA** - Physico-Chemical Properties and Structural Characterization of Iron Oxide Containing Glasses
P28.	**Mihai TOFAN** - Influence of Alloying Elements on the Stability and Performance of Cobalt Alloys for Medical Applications
P29.	**Andrei PRUTEANU** - Biofunctionalization of Titanium-Molybdenum Alloys for Biomedical Applications
P30.	**Marian Cristian STAICU** - Design Optimization and Mechanical Assessment of a Cryogenic Liquid Oxygen Storage System for Industrial Applications

Program of EUROINVENT ICIR Conference
POSTER PRESENTATION

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

	DAY 2 – FRIDAY MAY 09
	Poster Session 2 Chairman: Prof. Dr. Muhammad Mahyddin RAMLI Prof. Dr. Traian Florin MARINCA Prof. Dr. Ovidiu NEMES
P31.	**Gultekin GOLLER** - Gadolinium Zirconate based Functionally Graded Thermal Barrier Coatings
P32.	**Georgiana-Diana GABUR** - Grape Pomace: A Circular Economy Approach to Valorizing a Sustainable By-Product
P33.	**Vilyana KAZANLAKLIEVA** - Investigation of Antioxidant Activity of Low Molecular Phenolic Compounds from Waste Hydrolyzed Lignocellulosic Material
P34.	**Mykola ORLENKO** - Restoration of Architectural Objects' Stucco Décor: Ukrainian Experience
P35.	**Karol WYSZNACKI** - Revitalization and Reconstruction of the Tenement House at Tuwima 48 in Lodz and the Traditional Architecture of the City
P36.	**Oleksandr MOLODID** - Research Work in Developing Design Solutions on the Example of Soil Reinforcement under the Foundations of Supports of Stairs to the Magdeburg Law Monument in Kyiv
P37.	**Sylwia KRZYSZTOFIK** - Re-use of Industrial Heritage as an Element in Achieving Urban Resilience, Adaptation Complex of Textile Industry into a Shopping Centre, Lodz, Poland
P38.	**Shiru WANG** - Polychrome Sculpture in the Interiors of Dunhuang Sanctuaries, its Periodization Abd Artistic-Picture Features
P39.	**Anna Maria MARTYKA** - Exploring Innovative Methods for Assessing the Development Potential of Historic Architectural Structures: A Case Study of Small Medieval Towns in Subcarpathia
P40.	**Sylwia KRZYSZTOFIK** - Revitalization of Historic Districts as a Tool to Enhance Urban Resilience of the City on the Example of LodzAA
P41.	**Oleg SLEPTSOV** - Wall Painting as Characteristic Décor of Ukrainian Churches: Experience of the Ukrainian Restoration School
P42.	**Oleksandr KULIKOV** - Regeneration Problems of the Odesa Historical Environment in the Conditions of Post-War Reconstruction
P43.	**Adriana CATRUC** - Smart Energy Comfort: Optimizing Home Climate with AI and Thermal Inertia
P44.	**Joanna BARTKIEWICZ** - Selected Problems of Cultural Heritage Protection in a Small Historic Town based on the Example of Głogów Małopolski
P45.	**Dominika CENDA** - Architectural Transformations of Multifamily Housing from 1960–1980 in Poland: Preservation of Detail and the Impact of Thermal Modernization
P46.	**Andriana SURLEVA** - Chemical Characterization of Biomaterials Based on Advanced Titanium Alloys Using Biological Model Solutions
P47.	**Barbara ROBAK** - Leisure Architecture of the 1960s and 1970s as an Example of Post-War Modernism
P48.	**Svitlana LINDA** - Preliminary Design Studies of the Sculptural Decor of a Renaissance House at 23 Rynok Square in Lviv
P49.	**Oleksandr MOLODID** - Restoration of Ceilings in Buildings Damaged as a Result of over-Design Impacts, while Preserving the Established Urban Environment
P50.	**Alexandru STRATAN** - The Impact of Climate Change on Food Security in the Republic of Moldova
P51.	**Daniel CRISTISOR** - Mechanical Finishing of the APS-Coated Surfaces
P52.	**Madalin FARCAS** - Surface Engineering of PLA – 3D Printed Parts by Laser Melting
P53.	**Tatiana BUSE** - Assessment of the Influence of Ammonium Loading from Wastewater on the Photosynthetic Activity of Microalgae
P54.	**Calin-Virgiliu PRICA** - Double-Sintering of Invar36 Mechanically Alloyed Powders
P55.	**Argentina Niculina SECHEL** - Structural Characterization of Ti/B4C/(±Ni) Composite Powders Obtained by Mechanical Milling
P56.	**Roland Tibor BARTA** - Shear Performance of Hollow Clay Block Masonry Infill Walls with Precompression
P57.	**Anca CAZAC** - Phosphate Coatings Based on Strontium Used in Biomedical Applications: A Short Review
P58.	**Mihai POPA** - Effects of SLM Printing Parameters and Heat Treatments on the Corrosion Resistance of a Biocompatible Co-Cr-W Alloy
P59.	**Nurin Aisyah AHMAD OMAR** - Mechanical and Conductive Properties of Silicone Filled Graphene Electrically Conductive Adhesive (Eca)
P60.	**Mihai POPA** - Heat Treatment Effects on the Structure and Properties of SLM Printed Co-Cr-W Alloy
P61.	**Ruzaidi GHAZALI** - Towards Sustainable Waste Management: Innovations and Research Endeavors at Universiti Malaysia Terengganu
P62.	**Marcin NABIAŁEK** - Core Losses in the Remagnetization Process of Soft Amorphous Fe Based Alloys

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

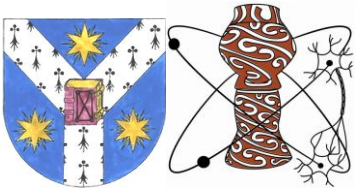
Universiti Malaysia Perlis (UniMAP) is Malaysia's 17th public institution of higher learning. It was approved by the Malaysian Cabinet on May 2001. Originally known as Kolej Universiti Kejuruteraa Utara Malaysia (KUKUM), or Northern Malaysia University College of Engineering, it was renamed as Universiti 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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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 2025 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

Seiji YAMAGUCHI, PhD

Associate Professor

Department of Biomedical Sciences, College of Life and Health Sciences,

Chubu University, Japan

Dr. Yamaguchi is an associate professor at the Department of Biomedical Sciences, College of Life and Health Sciences, Chubu University, Japan. He earned his doctorate in Energy Science from Kyoto University. Coauthor of 61 scientific articles, 12 review articles, 11 book chapters, and 13 patents. His work focuses on developing bioactive titanium metals and alloys for orthopedic and dental applications through solution and heat treatment. This method incorporates functional metal ions such as Ca, Sr, Mg, Zn, and Ag into titanium surfaces, imparting bone-bonding and antibacterial properties without cytotoxicity. He has also combined additive manufacturing with this treatment to create porous titanium that promotes early bone ingrowth and sustained antibacterial activity. Additionally, his research revealed that both positively and negatively charged titanium surfaces enhance apatite formation in simulated body fluid. Based on these findings, he developed a custom titanium plate for mandibular bone fixation, commercialized in Japan since 2022.

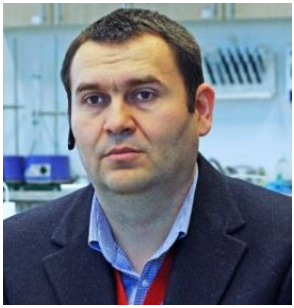
BIOACTIVITY AND ANTIBACTERIAL PROPERTIES IMPARTED TO TITANIUM METAL THROUGH SURFACE CHEMICAL TREATMENT: DEVELOPMENT OF ADDITIVELY MANUFACTURED TITANIUM DEVICES CONTRIBUTING TO HARD TISSUE REGENERATION

We applied various chemical-heat treatments to titanium and its alloys, analyzing surface changes and apatite formation which is crucial for bone bonding. Our findings revealed that electrostatic interactions, driven by positive or negative zeta potential, are key to apatite formation, while micro-/nano-scale surface roughness enhances cell activity. The mixed acid-heat treatment creates a positively charged titanium dioxide with micro-scale roughness, promoting apatite formation, increased ALP activity, and mineralization of MC3T3-E1 cells, with strong in vivo bone bonding. This treatment was applied to the fully custom mandibular reconstruction fixation plate 'CosmoFix,' utilizing additive manufactured titanium, which was launched in August 2022. This fixation plate is designed to fit the affected area, eliminating the need for intraoperative bending. On the other hand, Iodine treatment, using NaOH-CaCl2-heat-ICl3, forms a nano-structured iodine-containing calcium-deficient calcium titanate layer with sustained release of calcium and iodine ions. When applied to a titanium porous scaffold (900-600-300 µm pores), it produced a bioactive layer with enhanced apatite formation within 3 days in a simulated body fluid and long-lasting antibacterial activity for 90 days. Such scaffolds show promise for dental implants, spinal devices, and bone grafts.

Keynote Speaker

Anton FICAI, PhD

Professor
Faculty of Chemical Engineering and Biotechnologies,
National University of Science and Technology
POLITEHNICA Bucharest Romania



Anton FICAI is full professor and PhD advisor in the Faculty of Chemical Engineering and Biotechnologies, National University of Science and Technology POLITEHNICA Bucharest being actively involved in both academic and scientific life of the university. His major academic interests are related to Composite Materials for Medicine, NanoBioMaterials for Tissue Engineering and Drug Delivery Systems. The research interests are much broader, having the chemical approaches in the center, and cover the following topics: tissue engineering; drug delivery systems; multifunctional materials; composite materials; coatings, antimicrobial / antitumoral materials; nanoparticles synthesis and characterization; surface modification; etc. Till now, over 350 scientific papers, from which over 300 ISI papers and 22 books or chapters (including 2 edited books) were published along with 28 patent applications (10 of them being already released). The international recognition of the R&D activity can be highlighted by the multiple invitations for participate as speaker at international conferences, the positions of guest editors, member of the editorial boards of different national and international journals as well as Section Editor in Chief of Coatings. Valedictorian of UPB, former participant and laureate of the National Chemistry Olympiads he was awarded with over 150 Gold Medals, Special Awards or Best Paper Awards and recently, he was awarded with the Special Award for Transfer of the Research Results into Economy by the Ministry of Resort during the First edition of the "Gala Cercetării Româneşti". He is also full member of The Academy of Romanian Scientists and several professional societies.

DRUG DELIVERY SYSTEMS FOR LOCO-REGIONAL AND TARGETED CANCER TREATMENT

Cancer is the second cause of death, worldwide. Considering the high toxicity of the chemotherapeutic drugs, targeted and loco-regional delivery is a need to avoid the severe side-effects. The presentation will be mainly focused on two topics, one related to loco-regional treatment of the bone cancer while the second is related to the targeted delivery of the chemotherapeutic drugs using "trojan horses" with enhanced cellular uptake. In the first case, the localized bone cancer treatment is mainly based on surgery, radio and chemotherapy and considering the surgical intervention for resection of the tumoral tissue, the implantation of the smart drug delivery systems can be a solution to assure loco-regional therapy and to avoid the systemic administration/toxicity. In targeted delivery, the main aim is to develop carriers able to specifically target the tumoral cells and, followed their internalization, to release the chemotherapeutic drug intracellularly. All these smart drug-delivery systems are designed with the major aim to develop personalized therapies for cancer treatment.

Keynote Speaker

Joao NUNES-PEREIRA, PhD

Researcher
Centre for Mechanical and Aerospace Science and Technologies, Faculty of Engineering,
University of Beira Interior, Covilhã, Portugal

João Nunes-Pereira (JNP) is Assistant Researcher at the Centre for Mechanical and Aerospace Science and Technology (www.aerospace.ubi.pt), at the Faculty of Engineering, University of Beira Inteior, Covilhã, Portugal. JNP is co-author of more than 50 indexed publications (h-index 29), 3 book chapters and more than 50 scientific communications. JNP develops research activities in the field of Materials Science and Engineering, focusing on the design of multifunctional composites based on polymers or ceramics for the development of sensors and actuators to be applied in several industries such as aerospace, automotive, wind turbines, biomedical.

FROM DESIGN TO APPLICATION: STRATEGIES FOR DEVELOPING PIEZORESISTIVE COMPOSITES FOR STRUCTURAL HEALTH MONITORING

This study presents a systematic approach to the design, development and characterisation of piezoresistive composites with a focus on their application in Structural Health Monitoring (SHM). Key strategies for material selection, processing methods and optimisation of electrical and mechanical properties are explored following a structured methodology that includes: 1) the growing importance of composites in high-value sectors, with a particular ficus on aerospace, analysing the increasing market value of composite-based industries, highlighting the growing demand for lightweight and high-performance materials and considering the economic, safety and environmental benefits of smart structures. 2) the design of piezoresistive composites considering the influence of reinforcing filler and polymer matrix properties. The effect of filler content on electrical conductivity and percolation threshold versus piezoresistive sensitivity (gauge factor). 3) the characterisation of the developed materials focusing on mechanical performance and electrical response under mechanical loading and determination of gauge factors. The role of cyclic loading and strain sensitivity in assessing their suitability for SHM applications. 4) application to case studies in the aerospace industry, demonstrating the feasibility of piezoresistive sensing in laminated composites, single-lap bonded joints and auxetic sandwich structures. The potential for integrating these materials into real aerospace components for in-situ structural integrity monitoring is demonstrated.

Invited Speaker

Hasan GÖÇMEZ, PhD

Professor
Department of Metallurgy and Materials Engineering,
Faculty of Engineering
Kutahya Dumlupınar University, Turkey

Prof. Hasan Gocmez received his BSc degree from the Department of Metallurgical Engineering of Middle East Technical University, Turkey in 1994, and his MSc and Ph.D. degrees in Material and Ceramic Engineering departments from the Rutgers University-New Jersey, the USA in 1997 and 2001, respectively. Japan Society awarded him for Promotion of Science as a JSPS fellow between 2006 and 2007 to do research at Yamaguchi University. He was a visiting scientist at AIST, Stockholm University, Stevens Institute of Technology, and KTH. He is a Professor in the Department of Metallurgical and Materials Engineering at Kutahya Dumlupinar University. His research focuses on ceramic processing, nanomaterials, and energy storage systems such as solar cells and lithium-based batteries. In the meantime, he is an expert on the synthesis, dispersion, and stability of ceramic nanoparticles and the preparation for energy storage applications. He has one patent and more than 100 publications, including articles, conference proceedings, and others, with over 1200 citations reported by Google Scholar (H-index=17).

BORIDE BASED MATERIALS FOR SUPERCAPACITOR ELECTRODES

This research focuses on the synthesis of metal borides using a cost-efficient, solution-based approach for application in supercapacitor electrodes. The powders are synthesized from boric acid and metal precursors and are characterized for their structural and morphological features through techniques such as XRD, FE-SEM, EDS, DTA-TG, FTIR, Raman, and EPR. Electrochemical testing is carried out using a Parstat MC multi-channel potentiostat, with the metal borides serving as electrodes in symmetric and asymmetric device setups. In asymmetric configurations, graphite or multilayer carbon nanotube powders are used as the complementary electrode. Electrochemical impedance spectroscopy (EIS) results highlight the superior capacitive performance of the materials, showcasing their promise for energy storage and microdevice applications in modern electronics.

Invited Speaker

Rozyanty RAHMAN, PhD

Associate Professor
Universiti Malaysia Perlis

Assoc. Prof. Dr. Rozyanty Rahman is a distinguished researcher, academic leader, and expert in Polymer Composite, specializing in sustainable materials, bio-composites, nanocomposite and polymer science. She obtained her Ph.D. from Universiti Sains Malaysia in 2012, with a focus on UV-cured nanocomposites reinforced with natural fibers. Dr. Rahman has authored numerous publications in high-impact journals, including Materials, Polymer Testing, Composite Structure and Applied Polymer Science. Her groundbreaking research on natural fiber-reinforced composites, bio-based materials, nanocomposite and surface treatments for enhanced material performance has significantly advanced the field of sustainable polymer science. Dr. Rahman is widely recognized for her contributions to both academia and industry, having published over 80 papers in ISI and Scopus-indexed journals. Her work is frequently cited by researchers globally, reflecting her pivotal role in shaping modern composite material technologies. Her research and innovation have earned her numerous awards, including the Gold Award at the IPITEx 2021 for her research on Eco-Friendly Hybrid Railway Sleepers, the Special Award from the Association of Polish Inventors for her work on the Green Kenaf Soundproof Wall Panel 2019, and several prestigious international recognitions. As an Associate Professor at Universiti Malaysia Perlis and a key leader in the Centre for Graduate Studies, she has continued to lead innovative research that bridges the gap between sustainable practices and advanced material science.

POLYMER AND BIOCOMPOSITE INNOVATIONS: ADVANCING SUSTAINABLE MATERIALS IN AUTOMOTIVE APPLICATIONS

The automotive industry is shifting toward sustainability, with innovative materials like polymers and biocomposites playing a key role. This research explores recent advances in their use, aiming to boost vehicle performance, efficiency, and environmental responsibility. Polymers offer lightweight, durable, and versatile solutions, while biocomposites—sourced from renewables—help cut carbon emissions and fossil fuel dependence. High-performance biocomposites also enhance safety and support greener manufacturing. Topics include new processing methods, scalability challenges, and future trends, along with real-world applications in components from interior panels to structural parts. This session offers insights into how these materials are driving innovation and reducing the environmental footprint of the automotive sector.

Invited Speaker

Cristina-Ileana COVALIU-MIERLA, PhD

Professor
National University of Science and Technology POLITEHNICA
Bucharest, Romania

Prof.Habil.PhD Cristina-Ileana Covaliu-Mierlă from National University of Science and Technology POLITEHNICA Bucharest is a PhD supervisor in the field of Environmental Engineering and also is: Member of the National Council for the Attestation of University Titles, Diplomas and Certificates (CNATDCU); Director of the Doctoral School of Biotechnical Systems Engineering; ARACIS expert, Engineering Sciences field, Environmental Engineering area of expertise; She has an extensive scientific activity resulted in: 81+ ISI articles, of which 28 as main author holding over 613 citations, 5 books, 5 scientific projects, IH: 11. Expert in environmental studies, climate change and nonconventional depollution technologies.

SMART MATERIALS FOR WASTEWATER TREATMENT TECHNOLOGIES

The pollutants removal from wastewater for preventing reaching into the environment is intensively studied [1,2]. The paper presents different types of smart materials having the potential of removal toxic pollutants (heavy metals, drugs, etc.) from wastewater. The smart materials described in this articles were carbon nanotubes, zeolites, magnetic oxides, hybrid nanomaterials, composites nanomaterials. Also, will be outlined the correlation between the materials properties and their performance into the wastewater treatment technologies. The performances of the smart materials were systematically investigated from adsorption kinetics points of view. The wastewater treatment efficiency of pollutant removal was studied in different conditions: different pH (e.g. 4, 6, 8) of the wastewater and dose of adsorbent (e.g. 0.3 and 0.5 g). The results obtained for the smart materials tested demonstrate the possibility application of this adsorbents for the removal of pollutants from wastewater.

Invited Speaker

Dewi Suriyani CHE HALIN, PhD

Associate Professor Ts. Dr.
Faculty of Chemical Engineering & Technology,
University Malaysia Perlis (UniMAP), Perlis Malaysia.

Dewi Suriyani Binti Che Halin (PhD), currently she is an Associate Professor under the Materials Engineering Department at the Faculty of Chemical Engineering Technology, Universiti Malaysia Perlis and Head for Center of Excellence Geopolymer and Green Technology (CEGeoGTech), Universiti Malaysia Perlis. She was graduated with B.Eng with honours in Mineral Resources Engineering (2004) and Master in Science (M. Sc.) in Materials Engineering (2005) at the Universiti Sains Malaysia. She received her PhD in 2009 from the Universiti Kebangsaan Malaysia in the field of Materials Science specifically in the semiconductor materials. She was appointed as a Metallurgical Engineering Program Chairman (2010-2015). She is currently the member of Tin Solder Technology Research Malaysia under the Tin Industry Board (Research and Development), Malaysia, member of Malaysia Board of Technologist and member of Institute of Materials, Malaysia. She has experience working and lecturing in the surface engineering and electronic packaging materials field for more than 11 years. She was awarded a diploma with the rank of 'Knight' by The Committee of the Honarary Order "Pro Scientia et Innovatio" for her outstanding contributions to the promotion of science. She also received several awards from international and national organizations based her research in thin films materials. She has published more than 93 publications including proceedings, journals, books and modules as the main author and co-author with H-index 11. She has appointed as Visiting Research Fellow to take part in the Staff Mobility Programme within the framework of Erasmus Programme at Lodz University of Technology, Poland.

MICROSTRUCTURE EVOLUTION OF Ag/TiO2 THIN FILM

Ag/TiO_2 thin films were synthesized using the sol-gel spin coating method. Their microstructural evolution was studied through real-time synchrotron radiation imaging, with structural analysis via grazing incidence X-ray diffraction (GIXRD), morphological examination using field emission scanning electron microscopy (FESEM), and surface topography assessment by atomic force microscopy (AFM) in contact mode. Cubic Ag particles were observed alongside anatase TiO_2 with a porous, ring-like morphology. At 280 °C, ring structures began to merge, forming channels. Energy dispersive X-ray (EDX) analysis detected a small amount of Ag. Synchrotron imaging revealed that the growth area and number of junctions increased with annealing time. The growth rate was 47.26 $\mu m^2/s$ at 600 s, decreasing to 11.50 $\mu m^2/s$ at 1200 s, 11.55 $\mu m^2/s$ at 1800 s, and further down to 5.94, 4.12, and 4.86 $\mu m^2/s$ at 2400, 3000, and 3600 s, respectively.

SECTION 1

SYNTHESIS AND CHARACTERIZATION OF MATERIALS

Gadolinium Zirconate based Functionally Graded Thermal Barrier Coatings

Gultekin GOLLER[1,*]

[1] Department of Metalurgical and Materials Engineering, Istanbul Technical University, Maslak-Istanbul, Turkey

[*]goller@itu.edu.tr

Abstract. A traditional TBC system consists of ceramic top coat and metallic bond coat (MCrAlY). On the other hand, thermally grown oxide (TGO) layer forms between the bond coat and the ceramic top coat during operation at high temperature. The advanced new generation gas turbine engines need to operate at higher turbine inlet temperatures pushing the temperature limits of YSZ. As a result, alternative TBC materials should be selected having better thermal properties than YSZ under extreme conditions. Among the rare earth oxide materials, gadolinium zirconate (GZ) seems to be the most efficient one in terms of its low thermal conductivity, high phase stability and a very good resistant to damage by hot corrosion and CMAS attack. In this study, for the purpose of increasing the thermal cycling performance of GZ-based TBC, multilayered (ML) and functionally graded (FG) GZ/CYSZ (ceria and yttria stabilized zirconia) thermal barrier coatings were produced in 2, 4, 8 and 12 layered by high-velocity oxy-fuel (HVOF) and air plasma spraying (APS) processes. Thus, as top coat material, high thermal stability, CMAS, hot corrosion resistance and low thermal conductivity properties of GZ were combined with property of high CTE of CYSZ.

Keywords: thermal barrier coatings (TBC), thermally grown oxide layer, YSZ, CMAS, functionally graded materials.

Nuclear Magnetic Resonance in Tire Waste Mortars

Marta-Ioana MOLDOVEANU[1,*], Daniela-Lucia MANEA[1], Elena JUMATE[1], Raluca IȘTOAN[1], Radu FECHETE[2], Tudor-Panfil TOADER[3]

[1] Faculty of Civil Engineering, Technical University of Cluj-Napoca, 28 Memorandumului Street, Cluj-Napoca, Romania
[2] Faculty of Materials and Environmental Engineering, Technical University of Cluj Napoca, 25 George Barițiu Street, Cluj-Napoca, Romania
[3]NIRD URBAN-INCERC Cluj-Napoca Branch, 117 Calea Floresti, Cluj-Napoca, Romania

[*]marta_moldoveanu@yahoo.com

Abstract. Nuclear Magnetic Resonance (NMR) is one of the most modern and widely used methods for characterizing porous materials. In particular, it is used for standard mortars or those in which some components have been replaced. NMR is an advanced technique used for the characterization of materials, including cementitious compositions such as mortars containing tire waste. This method can provide us information on molecular structure, water distribution and the degree of cement hydration, which are essential for evaluating the mechanical performance and durability of these materials. NMR allows monitoring of the evolution of the cement hydration process in the presence of rubber granules from waste tires and also highlights changes in the structure of C-S-H gel (calcium-silicate-hydrate), which is responsible for the final strength of the mortar. We also can detect free water, weakly bound water and strongly bound water within the mortar structure, helping to understand how rubber granules influence porosity and permeability. Through NMR spectroscopy, interactions between tire waste and the hydrated cement phases can be investigated, determining material compatibility and possible chemical reactions.

Keywords: Nuclear Magnetic Resonance, tire waste, hydration, rubber granules, free water, mortar structure.

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Magnetotactic Bacteria in the Medical Field versus Magnetic Nanoparticles

Natalia PAUL[1,2,3], Catalin POPA[1,3], Rodica E. IONESCU[2,3,*]

[1] Materials Science and Engineering Department, Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, 400641 Cluj-Napoca, Romania
[2] Light, nanomaterials and nanotechnology (L2n) Laboratory, CNRS UMR 7076, University of Technology of Troyes, 12 Rue Marie Curie, CS 42060, CEDEX, 10004 Troyes, France
[3] Eut+ Institute for Nanomaterials & Nanotechnologies EUTINN, European University of Technology, European Union
[*]natalia.paul@stm.utcluj.ro, elena_rodica.ionescu@utt.fr

Abstract. Magnetotactic bacteria (MTB) is a heterogenous group of prokaryotic organisms with a ubiquitous distribution and some common, specific attributes. Magnetosomes are a distinctive feature of magnetotactic bacteria from other prokaryotic organisms and contain membrane-encased magnetic crystals arranged in chain-like structures that allow the cell to passively align itself along magnetic fields (magnetotaxis) [1,2]. Magnetic nanoparticles have a high popularity among nanotechnological processes and applications due to their structural, physicochemical properties and magnetic composition. They have a wide range of biotechnological uses in applications such as biomedicine, drug delivery, MRI imaging, cancer theranostics, biosensors, catalysis and bioseparation. Their use is limited by concerns related to biocompatibility risks – toxicity, mutagenicity and immunological rejection, low stability and not enough extended functionality in numerous therapies, treatments or devices [3]. Magnetic nanoparticles from magnetotactic bacteria (MTB-NPs) are much more promising compared to MNPs mainly due to their improved characteristics in terms of biocompatibility, functionalization and sustainability. Among the most important advantages we mention biocompatibility, reduced risk of toxicity and immunological rejection, increased stability and extended functionality in numerous therapies, treatments or devices [4]. Considering these aspects, MTB have multiple applications in the medical field, such as precised, targeted and personalized medicine thanks to reduced side effects, improved treatment efficacy and long-term survival rates, treatment for hard-to-treat diseases and development of new drug classes [5]. As part of our review, we performed a comparative analysis of recent studies highlighting the specific mechanisms through which MTB contribute to targeted drug delivery, and proposed a conceptual framework that integrates current findings with potential clinical applications.

Keywords: magnetotactic bacteria, magnetic nanoparticles, magnetosomes, biocompatibility, medical field applications.

Beta Stabilizing Elements and Their Mechanisms on Titanium Alloys

Ion GHICULESCU[1], Madalina Simona BALTATU[1], Ioan Gabriel SANDU[1], Andrei PRUTEANU[1], Andrei Victor SANDU [1,2], Petrica VIZUREANU [1,2,*]

[1] Faculty of Science and Material Engineering, Gheorghe Asachi" Technical University of Iasi-Romania, 41 Prof. D. Mangeron Blvd., Iasi, Romania
[2] Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, Bucharest, Romania

[*]petrica.vizureanu@academic.tuiasi.ro

Abstract. Unlike the hexagonal close-packed (HCP) alpha phase, the beta phase in titanium alloys has a body-centered cubic (BCC) structure, and beta stabilizing elements alter its thermodynamic stability. These stabilizers fall into one of two categories: eutectoid or isomorphous. Molybdenum, vanadium, and niobium are examples of isomorphous stabilizers that are completely soluble in the beta phase and that gradually decrease the beta transus temperature as concentration rises. On the other hand, when eutectoid stabilizers such as iron, chromium, and manganese cool down, they create intermetallic compounds. These elements add more electrons to the d-band than titanium, which affects atomic packing and bond character. They are distinguished by a higher electron-to-atom ratio. In comparison to the HCP phase, this electronic interaction makes the BCC structure more stable. When quenched, metastable beta alloys maintain their beta phase, but they may change as they age or experience stress. Ti-15V-3Cr-3Al-3Sn and Ti-10V-2Fe-3Al both exhibit high strength-to-weight ratios and good formability. Stable beta alloys have exceptional corrosion resistance and special elastic qualities because they contain enough stabilizers to keep the beta phase through thermal processing. This category is best represented by Ti-35V-15Cr. By altering microstructure, beta stabilizer concentration has a direct effect on mechanical properties. While yield strength, hardenability, and cold formability are improved by higher stabilizer content, ductility and fracture toughness may be decreased if not optimized. Thermomechanical processing and precise composition control enable phase distribution and morphology to be tailored to particular application requirements. These alloys are extensively utilized in affordable automotive parts, biomedical implants, and aerospace.

Keywords: beta stabilizing elements, titanium, medical applications.

Novel Ti-Mo-Zr-Ta Alloys for Orthopedic Applications: Development, Characterization and Performance Evaluation

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

[1] Faculty of Science and Material Engineering, Gheorghe Asachi" Technical University of Iasi-Romania, 41 Prof. D. Mangeron Blvd., Iasi, Romania
[2] Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, Bucharest, Romania

[*]petrica.vizureanu@academic.tuiasi.ro

Abstract. Titanium-based alloys are widely used in orthopedic applications due to their excellent biocompatibility and mechanical properties. However, challenges such as low wear resistance and high elastic modulus compared to natural bone necessitate continuous research for material optimization. This study focuses on the development and characterization of three novel titanium alloys: Ti15Mo7Zr5Ta, Ti15Mo7Zr10Ta, and Ti15Mo7Zr15Ta, processed using a vacuum remelting system. Energy dispersive X-ray (EDX) microanalysis confirmed the homogeneous chemical composition of the alloys, while optical microscopy revealed differences in grain morphology, with well-defined β-phase structures. X-ray diffraction (XRD) analysis identified a dual-phase structure composed of a body-centered cubic β-phase and an orthorhombic α"-phase, suggesting enhanced mechanical properties. Thermal analysis confirmed phase stability within the physiological temperature range (30-40ºC), ensuring the reliability of these materials for biomedical applications. Microhardness tests demonstrated hardness values ranging from 321.31 HV to 462.33 HV, with indentation tests revealing elastic modulus values between 43.57 and 76.88 GPa. The addition of β-stabilizing elements (Mo, Zr, Ta) effectively reduced the elastic modulus, bringing it closer to that of human bone (17-30 GPa). Increasing the tantalum content led to improved mechanical performance, making these alloys promising candidates for next-generation orthopedic implants.

Keywords: titanium-based alloys, orthopedic implants, biocompatibility, mechanical properties, vacuum remelting.

Acknowledgement: This work was supported by Bio-Simtit Grant of the Ministry of Research, Innovation and Digitization, CCCDI – UEFISCDI, project number PN-IV-P7-7.1-PED-2024-0080, within PNCDI IV.

Characterization and Optimization of Ti-Mo-Nb-Sn Alloys for Enhanced Biomedical Applications

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

[1] Faculty of Science and Material Engineering, Gheorghe Asachi" Technical University of Iasi-Romania, 41 Prof. D. Mangeron Blvd., Iasi, Romania
[2] Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, Bucharest, Romania

[*]petrica.vizureanu@academic.tuiasi.ro

Abstract. This study explores the hardness properties of novel Ti-Mo-Nb-Sn alloys tailored for biomedical applications, particularly focusing on how varying concentrations of Mo and Nb, with and without the addition of Sn, influence these properties. Our research analyzed four specific alloy compositions: Ti5Mo5Nb, Ti5Mo5Nb1Sn, Ti5Mo10Nb, and Ti5Mo10Nb1Sn. The findings highlight that adding 1% Sn distinctly impacts the hardness, with Ti5Mo5Nb showing a hardness of 353.8 HV, which is reduced to 302.9 HV with Sn addition. Similarly, Ti5Mo10Nb exhibited a hardness of 372.9 HV, which decreased to 269.0 HV when Sn was added. These results demonstrate the alloys' potential to be customized for varying demands in biomedical engineering, where reduced hardness can lead to improved wear resistance and compatibility with human tissue. The specific properties of Ti–5Mo–11Nb–7Sn, showing reduced hardness and potential for enhanced performance, make it particularly promising for use in high-stress implant environments, aligning with the need for more adaptive and durable biomedical materials.

Keywords: titanium alloys, biomedical engineering, hardness properties, Ti-Mo-Nb-Sn system.

Acknowledgement: This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS/CCCDI - UEFISCDI, project number ERANET-ERAMIN-3-Cool&SmartTit-1, contract no 8/2024 within PNCDI IV.

Freeze-Thaw Resistance of Geopolymer Composites with Waste Wood Addition

Dumitru Doru BURDUHOS NERGIS[1,2],
Petrica VIZUREANU[1,2*], Andrei Victor SANDU[1,2]

[1]Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University of Iasi, Prof. D. Mangeron Street, No. 41, 700050, Iasi, Romania
[2]Romanian Inventors Forum, Sf. P. Movila 3, Iasi, Romania

[*]petrica.vizureanu@academic.tuiasi.ro

Abstract. One of the latest approaches for replacing natural aggregates or fibers in geopolymers is the use of wood waste. Flours, wood chips, or wood fibers from discarded furniture or construction and demolition waste can be incorporated into geopolymers to obtain lighter products and, most importantly, to reduce the use of virgin raw materials. However, when combining inorganic and organic materials into a product that should last for thousands or hundreds of years, it is very difficult to fully assess the behavior of the resulting composites. Currently, the literature mainly addresses the influence of the type and amount of wood on the main properties of geopolymers, but a thorough evaluation of the long-term behavior of these wood-aluminosilicate mixtures is still needed. This study presents an evaluation of wood addition on the freeze-thaw resistance of geopolymers with 10, 20, and 30 wt.% wood content. Consequently, it was concluded that a small amount of wood particles will increase the mechanical properties of geopolymer composites. However, the presence of wood led to a slight decrease in durability due to water absorption and higher porosity of the resulting composite compared to the wood-free geopolymer.

Keywords: geopolymers composites, freeze-thaw, fly ash, wood addition.

Acknowledgement: This work was supported by a National Research Grants of the TUIASI, project number GNaC 2023_271/2024, Prefabricate inovative pe bază de compozite geopolimerice cu adaos de deșeuri lemnoase (Pre-Geo), Innovative products based on Geopolymer composites with waste wood addition (Pre-Geo).

Enhancing Fatigue Life in Hybrid Fiber Composites through Graphene Reinforcement

João PARENTE[1,*], Abílio SILVA[1],
Paulo N.B. REIS[2]

[1]Centre for Mechanical and Aerospace Science and Technologies (C-MAST), Universidade da Beira Interior, Rua Marquês d´Ávila e Bolama, Covilhã, Portugal
[2]University of Coimbra, CEMMPRE, ARISE, Department of Mechanical Engineering, Coimbra, Portugal

[*]joao.miguel.parente@ubi.pt

Abstract. Modern engineering requires lightweight yet durable materials resistant to fatigue. Advanced composite systems are being developed using hybrid fiber architecture and nanomaterials, such as graphene nanoplatelets (GNPs), offering benefits for aerospace, automotive, and wind energy sectors. This research explored the impact of combining carbon and glass fibers with GNPs between 0 wt. % and 1 wt. % on epoxy composites' bending-fatigue performance. The results indicated that 0.75 wt% of GNPs maximized bending strength, stiffness, and ILSS. Among the evaluated configurations, the 1G/7C hybrid laminate demonstrated the most effective performance. Fatigue testing revealed that while pure carbon laminates had the highest fatigue strength, hybrid laminates offered superior damage tolerance and extended fatigue lives. The GNP reinforcement provided additional fatigue life improvements ranging from approximately 9% to 15%. In conclusion, combining fiber hybridization with graphene-enhanced epoxy matrices presents a promising approach for developing next-generation composites that offer enhanced durability and fatigue resistance.

Keywords: hybrid carbon/glass composites; epoxy composites; graphene nanoplatelets; fatigue life; bending properties.

Acknowledgement: The authors are grateful for the support of the Portuguese Foundation for Science and Technology, I.P. (FCT, I.P.) through national funds (PIDDAC), under R&D Unit C-MAST/Centre for Mechanical and Aerospace Science and Technologies, reference: Projects UIDB/00151/2020 (DOI: 10.54499/UIDB/00151/2020) and UIDP/00151/2020 (DOI: 10.54499/UIDP/00151/2020). This research was also sponsored by national funds through FCT, I.P. under the projects UID/00285 – Centre for Mechanical Engineering, Materials and Processes and LA/P/0112/2020. J.M. Parente thanks FCT, I.P. for the grant UI/BD/151477/2021 (DOI: 10.54499/UI/BD/151477/2021).

Experimental Investigations on the Durability and Performance of Industrialized Products Used in the Wood Industry

Mirabela Georgiana MINCIUNA[1,2,]
Petrica VIZUREANU[1,2,*], Ioan Gabriel SANDU[1]

[1]Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University of Iasi, Prof. D. Mangeron Street, No. 41, 700050, Iasi, Romania
[2]Center of Excellence, Geopolymer & Green Technology (CeGeoGTech), School of Material Engineering, University Malaysia Perlis (UniMAP), Perlis, Malaysia

[*]peviz2002@yahoo.com

Abstract. The woodworking industry uses a wide range of industrial items, which are subjected to severe mechanical and tribological stresses. This paper presents experimental research that examined the behavior of various essential industrial parts used in the woodworking industry, with a focus on durability, friction coefficient and wear. The performance characteristics of the materials used were determined by friction and abrasion tests, combined with microstructural analysis and mechanical measurements. The results are useful for optimizing materials and component design, which increases the efficiency and durability of industrial equipment in this field.

Keywords: chemical composition, microindentation, friction coefficient, microstructure.

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Chemical Characterization of Biomaterials Based on Advanced Titanium Alloys Using Biological Model Solutions

Andriana SURLEVA[1,*], Luydmila ANGELOVA[1], Dimka FACHIKOVA[1]

[1]University of Chemical Technology and Metallurgy, 8 "st. Kl. Ohridski" blvd., 1756 Sofia, Bulgaria.

[*]surleva@uctm.edu

Abstract. The metallic biomaterials, especially Ti based materials, are the most used implants for human body regeneration. Although largely used, Ti alloys are still in the research focus in order to improve their durability, stability and biocompatibility. This study aims to identify the recent trends in characterization of advanced biomaterials based on metal alloys. Especially the recent advances in assessment of the behavior of Ti-based alloys in the classical and modified SBF (simulated body fluid), Ringer, Hank and Hartmann solutions, as well as other bioactive model media, are discussed. A comparative study of current analytical techniques and procedures applied to estimate biomaterial behavior is presented. The advantages and limitations of the most often applied protocols are critically discussed. The chemical composition and processes of the mostly used media to simulate the biological environment are summarized. The survey of the recent application of different biologically model media revealed that evaluation of Ti based alloys in model environments could be interpreted with consciousness of the differences between simulated and real environments in the living body. However, it should be noted that the chemical approach highly reduces the time, expert efforts and tools expenses to study properties of biomaterials

Keywords: biomaterials; biological fluids; chemical analysis; Ti alloys.

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Structure and Magnetic Properties of a Rapidly Cooled Alloy based on FeB

Tolga AYDIN[1,2], Marcin NABIAŁEK[2], Sebastian STAMBUŁA[2], Oliwia KUKUŁA[2], Bartłomiej JEŻ[3,*]

[1]Hacettepe University, Ankara, Turkey,
[2]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, Al. Armii Krajowej 19, Czestochowa 42-201, Poland
[3]Czestochowa University of Technology, Faculty of Mechanical Engineering, Al. Armii Krajowej 19c, Czestochowa 42-201, Poland

[*]bartlomiej.jez@pcz.pl

Abstract. The paper presents the results of research on the $Fe_{74}B_{20}Hf_2Nb_2Ti_2$ alloy produced using the method of pressing into a water-cooled copper mold. The obtained samples were characterized by an amorphous and nancrystalline structure. The samples were obtained in one stage. The process parameters were designed so that the cooling rate of the liquid alloy was different. The structure of the samples and magnetic properties were studied using an X-ray diffractometer, Mossbauer spectroscopy and a vibrating magnetometer. The effect of cooling rate on changes in the structure and magnetic properties was studied.

Keywords: bulk metallic glasses, amorphous alloys, soft magnetic properties.

Collagen-Hydroxyapatite Composite Wound Dressings Enhanced with Basil and Cinnamon Essential Oils

Alina ROBU[1,*], Madalina ALBU[2], Aurora ANTONIAC[1], Iulian ANTONIAC[1], Robert CIOCOIU[1]

[1]Faculty of Materials Science and Engineering, National University of Science and Technology Politehnica Bucharest, 313 Splaiul Independței Street, Bucharest, Romania
[2]National Research and Development Institute for Textiles and Leather, Collagen Department, 93 Ion Minulescu, Bucharest, Romania

[*]alinarobu2021@gmail.com

Abstract. Antibacterial dressings are used to prevent infections and promote the healing of various wounds by incorporating different antimicrobial agents. This study explores the development of new composite wound dressings. By incorporating hydroxyapatite and essential oils from basil and cinnamon into a collagen matrix and correlating the properties of each component, we aimed to obtain new products useful for patients who have developed antibiotic resistance. For all experimental samples, the same amount of hydroxyapatite (1%) at the same amount of collagen was used. Four samples, the reference sample A1R with no essential oils, A1B with basil essential oil, A1C with cinnamon essential oil and A1BC with both essential oils were made. The study evaluates the impact of additives on important properties, such as wettability, surface morphology, water absorption, enzymatic degradation and antimicrobial effect. The results showed that the experimental samples containing both essential oils appear to be the most promising biomaterials, with antimicrobial effect on both Escherichia coli and Staphylococcus aureus, due to the synergistic effect of their combination.

Keywords: wound dressing, collagen lyophilizate; basil essential oil; cinnamon essential oil; antibacterial activities.

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The Effect of Macconine on Lipid Accumulation in 3T3-L1 Preadipocytes and Molecular Docking on Pancreatic Lipase

Ubon RERKAM[1,2], Yuthana TANTISRUNGROTECHAI[1], Wandee INWONG[1], Praphakorn KAEMCHANTUEK[2], Sarunya LAOVITHAYANGGOON[2], Tanapak INYOD[2], Thanapat TERMAROM[2],Jiraporn ARUNPANICHLERT[1,*]

[1]Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathum Thani, Thailand
[2]Thailand Institute of Scientific and Technological Research, Pathum Thani, Thailand

[*]jira_550@tu.ac.th

Abstract. Macconine, a benzofuranone derivative isolated from the sclerotium of *Lignosus rhinocerotis* (Cooke) Ryvarden, was evaluated for its inhibitory effects on pancreatic lipase activity, lipid accumulation in 3T3-L1 adipocytes, and its interaction with pancreatic lipase through molecular docking assays. The results demonstrated that macconine significantly inhibited pancreatic lipase activity, with an IC_{50} of 103.12±2.31 µg/mL, exhibiting greater activity than the positive control, Orlistat, which had an IC_{50} of 202.10±4.06 µg/mL. Additionally, macconine (100 µg/mL) effectively reduced lipid accumulation in 3T3-L1 preadipocytes, by decreasing triglyceride (TG) levels by 27.77±5.22% and lipid deposits by 22.77±2.33%. This effect was comparable to the positive control Simvastatin (10 µg/mL), which reduced TG by 24.97±1.77% and lipid deposits by 11.46±0.79%. A molecular docking study revealed a favorable binding free energy of -6.342 kcal/mol, which is lower than that of Orlistat (-6.600 kcal/mol), suggesting that macconine binds well to the lipase enzyme through hydrogen bonding between its oxygen atom and amino acid residues surrounding the active site (PHE77 and SER152), as well as Pi-alkyl and Pi-sigma interactions between the aromatic ring and enzyme residues at ALA260 and LEU264. These findings indicate that macconine has potential as a treatment for obesity in food supplements. Further in vivo studies are required to evaluate its efficacy and safety.

Keywords: macconine, L. rhinocerotis, molecular docking.

Investigation of Mechanisms Leading to Early Aseptic Loosening of Hip Prostheses by Microscopical Techniques

Larisa POPESCU[1,*], Adriana ILEANA (BLAJAN)[1], Florin MICULESCU[1], Alina ROBU[1], Iulian ANTONIAC[1,2]

[1]National University of Science and Technology POLITEHNICA Bucharest, Faculty of Material Science and Engineering, Department of Materials Science and Physical Metallurgy, 313 Splaiul Independentei Street, 060042, Bucharest, Romania
[2]Academy of Romanian Scientist, Bucharest, Romania

[*]plarisa50@gmail.com

Abstract. This study focuses on analyzing the mechanism leading to early loosening of hip prosthesis. In many total hip arthroplasty procedures appear the interaction between hip prosthesis components, acrylic bone cement, and bone tissue. Acrylic bone cement has long been widely used in these interventions, and the importance of its interaction with bone tissue, as well as its penetration into the bone structure, has been extensively studied. Investigations using Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Analysis (EDAX) have provided detailed insights into these aspects, emphasizing the crucial role of uniform cement distribution in reinforcing and stabilizing the hip prosthesis components. Additionally, potential issues such as the formation of voids or cracks within the cement have been identified, which may compromise the long-term strength and stability of the hip prostheses. These findings highlight the necessity of a precise and controlled cementing technique to prevent such complications and ensure the success of the procedure. Furthermore, the study included a specific case in which the acrylic bone cement was applied in an excessively thick layer, resulting in deep penetration into the bone tissue. The lack of uniformity and low viscosity of the cement worsened the situation, underlining the importance of careful application to ensure both the stability and durability of the hip prostheses.

Keywords: biomaterials, hip prosthesis, bone cement, microscopy, failure.

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Analysis of the Mechanical Properties of Hardox Steel Coated with Different Materials

Cosmin NICOLESCU[1], Ana-Iulia BIȚA[1,*], Robert CIOCOIU[1], Marian MICULESCU[1], Iulian ANTONIAC[1]

[1]National University of Science and Technology POLITEHNICA Bucharest, Faculty of Material Science and Engineering, Department of Materials Science and Physical Metallurgy, 313 Splaiul Independentei Street, 060042, Bucharest, Romania

[*]anaiulia.bita@gmail.com

Abstract. The European defense industry depends on a wide range of materials that have unique properties that make them essential for military applications. Steel is a common choice for military applications, due to its durability being commonly used in defense items like vehicle armor and ballistic fillings of bulletproof vest. The two most important factors for steels used in defense applications are its mechanical strength and the ballistic limit. Ballistic protection request in generally an extremely strong barrier against most weapons. HARDOX steel is an example of a metallic material used in vehicle armor. New Hardox steel types are characterized by higher hardness. Hence, it is possible to formulate the thesis that the hardness index constitutes the main parameter quoted by the manufacturer to forecast and increase abrasion resistance in Hardox steel. These actions have some influence also on plastic material properties, which in the case of Hardox steel applications must be comprehensively analyzed together with abrasion resistance. The main objective of this paper was to evaluate the mechanical properties of the Hardox 450 steel induced by coating it with ceramic layer (Al_2O_3), respectively a polymeric layer (polyurea). Also, both coatings were characterized and assess the adhesion of these coatings on HARDOX 450 Steel.

Keywords: HARDOX steel, coatings, alumina, polyurea, adhesion, mechanical properties.

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Corrosion Behavior of Mg–based Alloys for Medical Applications

Ana-Iulia BITA[1,*], Cosmin NICOLESCU[1], Elena POPESCU[1], Aurora ANTONIAC[1], Alexandru STERE[1], Robert CIOCOIU[1], Iulian ANTONIAC[1,2]

[1]National University of Science and Technology POLITEHNICA Bucharest, Faculty of Material Science and Engineering, Department of Materials Science and Physical Metallurgy, 313 Splaiul Independentei Street, 060042, Bucharest, Romania
[2]Academy of Romanian Scientist, Bucharest, Romania.

[*]anaiulia.bita@gmail.com

Abstract. The most critical shortcoming of magnesium alloys from the point of view of medical devices is the high corrosion rate, which is not well-correlated with clinical needs. It is well- known that rapid degradation occurs when an implant made of Mg-based alloys is placed inside the human body. Consequently, the implant loses its mechanical properties and failure can occur even if it is not completely degraded. The corrosion products that appear after Mg-based alloy degradation, such as H_2 and OH^- can have an essential role in decreasing biocompatibility due to the H_2 accumulation process in the tissues near the implant. In order to control the degradation process of the Mg-based alloys, different coatings could be applied. The aim of the current paper is to evaluate the different testing medium on the corrosion behavior of magnesium-based alloys. The main functional properties required for the magnesium alloys to be used as implant materials, such as surface properties, were studied before and after surface modifications induced by immersion in simulated body fluids of different magnesium alloys. Also, the effect of some coatings on the magnesium-based alloys will b e evaluated in the same term of biodegradation in simulated body fluids. The experimental results showed that the influence of the chemical composition of the testing media are very relevant for the biodegradation rate. Also, the coatings could modulate the biodegradation rate.

Keywords: biomaterials, magnesium alloys, corrosion, degradation rate.

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Degradation Behavior of Various Magnesium Alloys in Simulated Body Fluids

Elena PIEPTEA (POPESCU)[1], Iuliana CORNESCHI[1,*], Aurora ANTONIAC[1], Maria Eleonora GHERGHINA (STEFAN)[1], Iulian ANTONIAC[1], Anca M. FRATILA[2]

[1]National University of Science and Technology POLITEHNICA Bucharest, Faculty of Material Science and Engineering, Department of Materials Science and Physical Metallurgy, 313 Splaiul Independentei Street, 060042, Bucharest, Romania
[2]Lucian Blaga University of Sibiu, 10 Bulevardul Victoriei, 550024, Sibiu, Romania

[*]iulicorneschi07@gmail.com

Abstract. Biodegradable structures are designed to be resorbed or dissolved spontaneously in the human body after the healing process, eliminating the need for secondary surgical removal. Among biodegradable materials currently studied—such as polymers, ceramics, and bioactive glasses—magnesium-based alloys have attracted increasing attention due to their superior mechanical properties and biocompatibility. The aim of this study was to investigate the corrosion behavior of several magnesium alloys from the Mg-Zn-Ag-Zr and Mg-Zn-Mn system. Corrosion performance was assessed through immersion tests by evaluating hydrogen gas release, pH variation, and mass loss, using simulated body fluid (SBF) as the testing environment. The results indicated that the addition of calcium and silver as alloying elements led to reduced corrosion resistance, suggesting a need for careful compositional balance in alloy design for biomedical applications.

Keywords: magnesium alloys, degradation, pH, mass loss, implants.

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Impact of Roasting on the Oxidative Stability of Walnut Oil During Thermal Processing Utilizing ATR-FTIR Spectroscopy in Conjunction with Chemometrics

Fatos REXHEPI[1,*], Ramize LEKU[1]

[1]Faculty of Food Technology, University "Isa Boletini" Mitrovica, Republic of Kosovo

[*]fatos.rexhepi@umib.net

Abstract. The impact of roasting on the oxidative stability of walnut oil was examined by analyzing the alterations in the properties of oils derived from unroasted and roasted kernels during thermal treatment at 180 °C. Walnut kernels were roasted at 140°C for 20 minutes before cold pressing for oil extraction. The roasting of kernels enhanced the thermal stability of the oil, as the viscosity and density of the oil underwent rapid alterations during heating. The rate of rise in density and viscosity of the oil was much lower in roasted walnut oil compared to unroasted walnut oil during heating at 180 °C. The roasting of kernels markedly elevated the induction period of walnut oil from 1.12 to 2.89 days during storage. The heating process resulted in reductions in the areas of the bands at 3007 and 722 cm^{-1}, as well as in the area ratios of 3007/2854 and 722/2854 cm^{-1} in both oil samples, indicating differences in oxidative stability between roasted and unroasted samples. Moreover, heating resulted in elevated areas of the bands at 3475 and 1744 cm^{-1}, as well as increased ratios of 3475/2854 cm^{-1} and 1744/2854 cm^{-1}, indicating the development of primary and secondary oxidation products in the heated oils derived from unroasted samples. All of these modifications, including PCA analysis, demonstrate that oil from roasted walnuts exhibits greater thermal stability than oil from unroasted walnut samples. This research demonstrated that oil oxidation may be efficiently and swiftly monitored using ATR-FTIR spectroscopy.

Keywords: walnut oil, FTIR, oxidation, thermal process.

Synthesis and Morpho-Structural Characterization of New Halogenosilane-Modified ZnO Nanoparticles

Mariana BUSILA[1], Andreea Veronica BOTEZATU[2], Alina-Mihaela CEOROMILA[3], Ana-Maria MOROSANU[4], Aurel TABACARU[2,*]

[1]Department of Materials and Environment Engineering, Faculty of Engineering, „Dunărea de Jos" University of Galați, 111 Domnească Street, Galați, Romania
[2]Department of Chemistry, Physics and Environment, Faculty of Sciences and Environment, „Dunărea de Jos" University of Galați, 111 Domnească Street, Galați, Romania
[3]Research and Development Center for Thermoset Matrix Composites, Cross-Border Faculty, „Dunărea de Jos" University of Galați, 111 Domneasca Street, Galați, Romania
[4]Institute of Biology Bucharest, Romanian Academy, 060031 Bucharest, Romania

[*]aurel.tabacaru@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. In this context, we here report a simple and low-cost method for the preparation of semiconductor zinc oxide nanoparticles (ZnO NPs) by chemical precipitation, using the halogenosilane species 3-chloropropyltrimethoxysilane (CPTMS), 3-bromopropyltrimethoxysilane (BPTMS) and 3-iodopropyltrimethoxysilane (IPTMS) as capping agents. Powder X-ray diffraction (PXRD), scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX), transmission electron microscopy (TEM) and Fourier transform infrared spectroscopy (FTIR) were employed to morpho-structurally characterize the obtained halogenosilane-modified ZnO NPs. In fact, the size and shape varied, depending on the type of halogenosilane used for surface modification. Thus, the unmodified ZnO NPs are larger and have a regular, predominantly spherical shape, while the ZnO NPs modified with halogenosilane species are smaller and have a diversified morphology, which suggests both an efficient surface modification and different nucleation and growth mechanisms. These morpho-structural features are considered crucial in view of applying them into potential biomedical applications, such as antitumor properties.

Keywords: ZnO nanoparticles, halogenosilanes, surface modification, chemical precipitation, morpho-structural characterization.

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Analysis of the Influence of Torsional Deformation Characteristics on Seawater Corrosion Resistance of 316 Stainless Steels

Magdalena Gabriela HUTANU[1,*], Ramona CIMPOESU[1], Elena Luiza EPURE[2], Carmen NEJNERU[1], Liviu ANDRUȘCĂ[3], Lucia-Daniela CHICET[1], Nicanor CIMPOESU[1]

[1]Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University of Iasi, Prof. Dr. docent D. Mangeron Blvd., Iasi, Romania
[2]"Cristofor Simionescu" Faculty of Chemical Engineering and Environmental Protection, "Gheorghe Asachi" Technical University of Iasi, Prof. Dr. docent D. Mangeron Blvd., Iasi, Romania
[3]Mechanical Engineering Faculty, "Gheorghe Asachi" Technical University of Iasi, Prof. Dr. docent D. Mangeron Blvd. Iasi, Romania

[*]magdalena-gabriela.hutanu@student.tuiasi.ro

Abstract. The enhanced corrosion resistance of 316 stainless steel can be attributed to its microstructure [1], which consists of solid solution grains with multiple intermetallic compounds inter- and intragranularly, and to the formation of a passive chromium oxide layer [2]. In the present work, the modification of the corrosion resistance of 316 stainless steel subjected to plastic field torsion at different rates and angles was investigated. The experimental samples were subjected to electrochemical corrosion tests (linear polarization technique) to observe the effect of the torsion rate. The surface microstructures and chemical analysis of the alloys before and after corrosion was analyzed by Scanning Electron Microscopy (SEM) and by Energy Dispersive X-ray (EDX). The tests were carried out at 5 ℃ and 25 ℃ temperature. The obtained results show that corrosion resistence variates with torsion rate, the highest corrosion rate was occurred at 20mm/min strain rate.

Keywords: 316 stainless steel, corrosion, deformation.

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Hardness Modifications through Heat Treatments on Cooper Alloy

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

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

[*]andrei-victor.sandu@academic.tuiasi.ro

Abstract. The paper presents an experimental study about the hardness modifications on copper alloy. The alloy is part of the brass category and his hardness can modify through quenching solution and ageing. After each heat treatment, the samples are prepared and the hardness were measured using Vickers method $HV_{100.}$ The structure was analyzed on electronic microscope, using various magnitudes.

Keywords: hardness, temperature, structure, sample.

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Disordered $Ni_2Mn_xSn_{1-x}$ off-Stoichiometric Heusler Alloy Formation with Low Sn Content by Mechanical Alloying

Florin POPA[1,*], Andra Teodora Anastasia MAN[1], Traian Florin MARINCA[1], Niculina Argentina SECHEL[1], Diana BENEA[2], Răzvan HIRIAN[2], Bogdan Viorel NEAMȚU[1], Ionel CHICINAS[1]

[1]Department of Materials Science and Engineering, Technical University of Cluj-Napoca, 103-105 Muncii Avenue, 400641 Cluj-Napoca, Romania
[2]Faculty of Physics, Babes-Bolyai University Cluj-Napoca, Kogalniceanu 1 Str., 400084 Cluj-Napoca, Romania

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

Abstract. Formation by high energy ball milling of the Ni_2MnSn Heusler alloy was investigated in the low Sn content. For the obtaining of the alloy, milling was pursuit up to 10 h of milling, starting from elemental powders. Upon milling, mixing of the elements occurs, and after 10 h of milling, a B_2 Heusler phase is obtained. The phase evolution through milling was studied and phase quantification using the Rietveld method applied to the recorded X-ray diffraction was made. For the Heusler phase, the mean crystallite size was computed and found to be in the nanometric range. Aspects regarding the particle size distribution were analyzed versus the milling time and phase formation. By scanning electron microscopy, the particle morphology was observed, and the chemical distribution of elements was determined by Energy Dispersive X-ray Spectroscopy. The magnetization of the samples was measured and found a decrease as the milling time increases, and B_2 phase is forming in the whole sample volume.

Keywords: Heusler alloys, mechanical alloying, nanocrystalline, magnetisation.

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Research on the Mechanism of the Corrosion Process of the Plate Corrosion of a Heat Exchanger from an Oil Refinery

George COMAN[1,*], Andrei BERBECARU[1], Elena MARGHIOALA[1], Mirela SOHACIU[1], Ecaterina MATEI[1], Andra PREDESCU[1], Karina STANICESCU SOLOMON[1], Andrei GRECU[1], Sorin CIUCA[1], Cristian PREDESCU[1]

[1]National University of Science and Technology POLITEHNICA Bucharest
Splaiul Indepenentei, 313, district 6, Bucharest, Romania

[*]george.coman@upb.ro

Abstract. The paper presents the research carried out on four plates from a heat exchanger located on a refinery platform in order to establish the causes that led to their accentuated corrosion. The chemical composition of the material, macro and microstructural analysis as well as the hardness characteristics are analyzed. The results obtained are compared with the provisions of the material standard mentioned in the equipment documentation. A separate chapter is the analysis by optical and electronic microscopy methods of the corrosion process developed on the surfaces of the plates. Finally, an assessment is made of the causes of premature failure of the plates due to their accentuated corrosion.

Keywords: corrosion process, steel, petrol industry, microstructural analyses.

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Corrosion Behaviour of Phosphate Coating Based Ca-Zn Deposited on Ti6Al4V Surface

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

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

[*]peviz2002@yahoo.com; [*]costica.bejinariu@yahoo.com

Abstract. The implant market is constantly growing due to the increase of traumas or bone diseases. Nowadays, many researchers try to improve the properties of the biomaterials used for implant manufacturing. Even though titanium and its alloys have good biocompatibility and mechanical properties, its corrosion behavior in contact with body fluids can increase the risk of inflammation and implant failure. Therefore, in order to enhance the corrosion resistance of the titanium alloy, Ti6Al4V, in this study, a Ca-Zn phosphate layer was deposited by the phosphate chemical conversion process. The corrosion behavior of the coating was studied in two corrosive solutions (Ringer and Dulbecco solution) by cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS). The results show a significant improvement in the corrosion resistance of Ti6Al4V by covering it with a Ca-Zn phosphate layer.

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

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Assessment the Efficiency of Green Corrosion Inhibitors for Steel Protection in Acidic Environment

Nicoleta BOGATU[1,*], Daniela BURUIANA[1], Viorica GHISMAN[1], Alina Crina MUREȘAN[1]

[1]Interdisciplinary Research Centre in the Field of Eco-Nano Technology and Advance Materials CC-ITI, Faculty of Engineering, "Dunarea de Jos" University of Galati, 47 Domneasca Street, 800008 Galati, Romania

[*]nicoleta.simionescu@ugal.ro

Abstract. Corrosion of steel in acidic environments remains a significant challenge in industries such as oil and gas, chemical processing, and metal refining, often resulting in structural degradation and high maintenance costs. While conventional corrosion inhibitors have been widely used, many contain toxic and hazardous substances that pose environmental and health risks. In recent years, there has been growing interest in green corrosion inhibitors derived from natural sources, offering a more sustainable and eco friendly alternative. This study analyses the effectiveness of green corrosion inhibitors derived from natural sources (plants) in protecting steel against corrosion in 1M sulfuric acid (H_2SO_4). The mechanisms of inhibition, efficiency assessment methods including electrochemical impedance spectroscopy (EIS) and surface characterization (SEM-EDX) are also discussed. The results demonstrate that these eco-friendly inhibitors significantly improve corrosion resistance, providing a sustainable and safer alternative for industrial applications.

Keywords: steel, green corrosion inhibitors, acidic environment, steel protection.

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Study on the Formation and Properties of the Deposited Layer on a Metallic Material in a Simulated Natural Oral Environment

Daniela BURUIANA[1], Alina Crina MURESAN[1], Nicoleta BOGATU[1], Viorica GHISMAN[1,*]

[1]Interdisciplinary Research Centre in the Field of Eco-Nano Technology and Advance Materials CC-ITI, Faculty of Engineering, "Dunarea de Jos" University of Galati, 47 Domneasca Street, 800008 Galati, Romania

[*]viorica.ghisman@ugal.ro

Abstract. This study investigates the formation and characteristics of a surface layer developed on a metallic material after exposure to a simulated natural oral environment. The objective was to evaluate the interaction between the metallic substrate and the components of the medium, aiming to understand the material's suitability for potential biomedical or dental applications. A comprehensive analysis was performed, including morphological assessment using scanning electron microscopy, chemical compositional analysis through energy-dispersive X-ray spectroscopy (EDS), structural characterization by Fourier Transform Infrared Spectroscopy (FTIR), and electrochemical testing to determine corrosion behavior. The results revealed the formation of a heterogeneous surface layer with distinct morphological and chemical features, indicating a dynamic interaction at the interface. FTIR spectra confirmed the presence of organic and inorganic compounds typical of an oral-like environment, while corrosion tests demonstrated the protective or degradative potential of the layer formed. These findings contribute to the understanding of material performance in biologically relevant conditions and support future developments in biocompatible metallic devices.

Keywords: metallic material, layers, properties.

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Study on the Structure of Different Materials Used in the Manufacture of Medium-Caliber Ammunition

Tiberiu Alexandru PIRVU[1], Daniela BURUIANA[1,*], Viorica GHISMAN[1], Gabriel Bogdan CARP[1]

[1]Interdisciplinary Research Centre in the Field of Eco-Nano Technology and Advance Materials CC-ITI, Faculty of Engineering, "Dunarea de Jos" University of Galati, 47 Domneasca Street, 800008 Galati, Romania

[*]daniela.buruiana@ugal.ro

Abstract. The aim of this study is to investigate the structural and performance characteristics of materials used in medium-caliber multipurpose ammunition. The research focuses on the analysis of various metallic and composite materials commonly utilized in the construction of projectile components, including penetrators, liners, and casings. Advanced characterization techniques were employed, including Scanning Electron Microscopy (SEM) for surface morphology analysis and Energy Dispersive X-ray Spectroscopy (EDX) for elemental composition mapping. The research aims to establish correlations between the material structure, manufacturing processes, and functional performance under dynamic loading conditions. Mechanical testing, hardness evaluation, and thermal stability assessments were conducted to determine the suitability and reliability of various alloys and structural configurations. The results of this study indicate that the investigated materials exhibit distinct structural and mechanical behaviors under ballistic and thermal stress conditions. These differences are directly influenced by their microstructural composition, manufacturing processes, and inherent physical properties.

Keywords: structural analysis, ballistic performance, medium-caliber ammunition.

Acknowledgement: This work was funded by "Dunarea de Jos" University of Galati, Romania, grant research no. 7954/31.03.2025.

The Effect of Ni, Cu and Cs Ions Incorporation on the Physico-Chemical Characterizations of Geopolymers

Mouna SELLAMI[1,*], Ali BEN AHMED[2], Andrei Victor SANDU[3], Mohamed TOUMI[1]

[1] Laboratory of Chemical-Physics of Solid State, Department of Chemistry, Faculty of Sciences of Sfax, University of Sfax, B.P. N°802, 3018 Sfax, Tunisia
[2] Laboratory of Applied Physic, Department of Physic, Faculty of Sciences of Sfax, University of Sfax, B.P. N°802, 3018 Sfax, Tunisia
[3] Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iasi, Romania

[*]mouna.sellami@fss.u-sfax.tn

Abstract. This study investigates the structural and optical properties of acid-based geopolymers doped with nickel (Ni), copper (Cu), and cesium (Cs) ions. The geopolymers were synthesized via the phosphoric acid activation of metakaolin. The stabilization procedure of the consolidated Ni/Cu/Cs-geopolymers consists of sintering these samples at 1000 °C for 2 h, to get, in the end, ceramic glasses [1]. Each compound was characterized using X-ray diffraction (XRD), Raman spectroscopy, infrared (IR) spectroscopy, and ultraviolet-visible (UV-Vis) spectroscopy. The phase identification of samples revealed an amorphous phase, evidenced by a broad hump in XRD patterns.
The structural analysis of Ni-doped geopolymers identified crystalline phases of tridymite (SiO_2), aluminum phosphate ($AlPO_4$), and nickel orthosilicate (Ni_2SiO_4). In Ni-Cu-doped systems, cristobalite (SiO_2) and $AlPO_4$ phases were observed, while Ni-Cu-Ce-doped geopolymers exhibited tridymite (SiO_2), $AlSi_2P_3O_{12}$, and cesium dihydrogen phosphate (CsH_2PO_3). Vibrational spectroscopy (Raman and IR) corroborated the structural findings, and UV-Vis analysis provided insights into the optical properties and band gap behavior of the synthesized materials. This work highlights the influence of transition and alkali metal dopants on the crystallization and optical characteristics of acid-based geopolymers, offering potential implications for tailored material design.

Keywords: geopolymer, metals doping, structural analysis, optical properties.

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Using Organic Substaneces as Green Corrosion Inhibitors for Carbon Steel in HCl Solution

Claudia CRISAN[1,*], Horațiu VERMEȘAN[1], Anca STEFAN SICOE[1], Nicoleta ZDROB[1]

[1]Department of environmental engineering and sustainable development entrepreneurship, Technical University of Cluj-Napoca, 400641, Cluj-Napoca, Romania

[*]claudia.crisan@imadd.utcluj.ro

Abstract. In recent years, research has focused heavily on employing green chemistry practices for more sustainable manufacturing processees. Acid pickling is a vital stage in metal manufacturing during which the material is suscceptible to corrosion if the process is not managed properly. Adding green corrosion inhibitors to the acidic solution used is one solution to this importat problem that the industry faces today. This paper explores the use of two different organic substaneces, tea tree essential oil and the expired drug Sinecod, as green corrosion inhibitors for carbon steel in concentrated chlorohydric acid. Corrosion behavior is tested by weight loss method, potentiodynamic polarization and electrochemical impedance spectroscopy for 3 concentrations of inhibitor (1, 2, 3%) and a Blank sample. The mechanism of inhibition was also investigated by fitting the electrochemical data to adsorption isotherms such as the Langmuir and Freundlich models. The optimum concentration proved to be 3% for both substances with inhibition efficiencies up to 80% in the case of tea tree essential oil and up to 70% in the case of expired Sinecod, showing that the inhibitor concentration and inhibitor efficiency are directly correlated in this case. The findings of this study show the possibility of using expired pharmaceutical compounds or natural extracts as corrosion inhibitors for the concentration of acid solutions uised for industrial processing.

Keywords: green corrosion inhibitors, expired drugs, natura extracts, carbon steel, corrosion management.

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Investigation of the Thermogravimetric and Mechanical Behavior of a Novel Reinforced Composite Material

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

[1]Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, 400641, Cluj-Napoca, Romania

[*]ovidiu.nemes@imadd.utcluj.ro

Abstract. This research focused on the thermal and mechanical characterization of a composite material obtained from a mixture of recycled plastic materials. The manufacturing process was thermoforming, considering the thermoplasticity of the polymers used - ABS and PMMA. The result obtained from thermoforming is a composite material with non-oriented short fibers, where the matrix is formed from the previously mentioned polymers (ABS, PMMA), and the reinforcement consists of glass fibers. For the characterization of the new ecological material, thermogravimetric analysis was performed, considering the potential areas of use: reinforcement elements in sanitary ware manufacturing or elements of public structures. Among the available recycling methods (thermal, mechanical, and solvolysis), thermoforming is the most suitable, considering that the finished product has added economic value, thus making the recycling process a circular one where the supply chain loop is closed [1]. The results obtained are satisfactory and demonstrate the thermal stability of the material at different temperatures. Mechanical tests carried out (tensile, flexural, and compression) have shown that the material exhibits predictable behavior and can be successfully used in the design and fabrication of reinforcement structures. Future studies will focus on the morphostructural characterization of the material for a better understanding of the matrix - reinforcement interactions necessary due to layers of metalic mesh used as reinforcement.

Keywords: polymers, recycling, sustainability, mixed waste.

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Studies and Research about Obtaining Natural Fiber-based Eco-materials

Oana-Roxana LAPUSAN (HANDABUT)[1,*],
Ovidiu NEMES[1]

[1]Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, 400641, Cluj-Napoca, Romania

[*]oana.lapusan@campus.utcluj.ro

Abstract. Natural fiber composites (NFCs) [1] represent a rapidly growing class of materials, valued as environmentally friendly, sustainable and low-cost alternatives to traditional composites materials. This study comprehensively examines the advancements in NFCs, focusing on crucial aspects: fiber surface treatments, resulting composite properties, and expanding applications. Key advantages of driving research include the biodegradability and renewability of natural fibers like flax, jute, hemp, wool, and bagasse, enabling their use in automotive, construction, packaging, and insulation sectors. However, significant challenges persist, primarily the inherent hydrophilicity of natural fibers leading to moisture sensitivity, and poor interfacial adhesion with common hydrophobic polymer matrices, which can compromise performance and durability. This study presents various surface modification strategies employed to overcome these limitations, including chemical treatments, plasma treatments, biological methods, and the incorporation of coupling agents or nanofillers. The impact of these treatments on enhancing fiber-matrix bonding and improving mechanical properties, thermal insulation, and wear resistance is critically assessed. It highlights the distinct contributions of different fibers, such as the notable specific stiffness of flax and the excellent thermal/acoustic insulation and fire retardancy of sheep wool. Furthermore, the potential of hybrid systems, combining fibers like flax and wool to leverage complementary characteristics, is discussed. Finally, the study outlines current applications and future perspectives, emphasizing the need for continued innovation in treatments, design, and long-term durability assessment to facilitate wider adoption of these sustainable materials in more demanding technological fields.

Keywords: natural fiber composite, polymers, sustainability.

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Corrosion Behavior of Mild Steel in Aqueous Solutions of Ammonium Nitrate

Dimka FACHIKOVA[1,*], Ludmil FACHIKOV[1]

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

[*]dimkaivanova@uctm.edu

Abstract. The aqueous ammonium nitrate solutions are media exhibiting strong corrosive attacks to mild and low alloy steels resulting in general or local corrosions. The corrosion aggressiveness of aqueous ammonium nitrate solutions is higher than that of alkali and alkaline earth metals mainly due to their lower pH and the complex nature of $NH4^{+}$-ions, which in general, facilitates the passage of Fe^{2+}-ions in the medium. Corrosion of iron and mild steel in NH_4NO_3-solutions have been studied, as a rule, by conventional methods and without providing information of the corrosion products, the probable reactions controlling the corrosion process are predicted. This work addresses the corrosion-electrochemical behavior of low-carbon mild steel (0.17%C) in aqueous solutions of ammonium nitrate. Electrochemical, physical, analytical and metallographic methods have been applied. The corrosion-electrochemical parameters of the steel have been determined depending on the concentration, temperature and pH of the medium, as well the effects of the thermal treatments-quenching and annealing at temperatures in the range of 200÷600°C. Under these conditions, the steel shows susceptibility or resistance to stress corrosion cracking (SCC). The corrosion products were determined by a Mössbauer analysis in order to correlate them with the corrosion behaviours of tested steels.

Keywords: corrosion, mild steels, nitrate solutions, Mö-spectroscopy.

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Characterization of Molybdenum-Doped Titanium Composites Obtained by Spark Plasma Sintering

Paweł FIGIEL[1,*], Rafał RUBACH[2],
Anna BIEDUNKIEWICZ[1], Dariusz GARBIEC[2]

[1]Faculty of Mechanical Engineering and Mechatronics, West Pomeranian University of Technology in Szczecin, 19 Piastów Av., 70-310 Szczecin, Poland
[2]Łukasiewicz Research Network – Poznań Institute of Technology, 6 Ewarysta Estkowskiego St., 61-755 Poznań, Poland

[*]pfigiel@zut.edu.pl

Abstract. This study investigates titanium matrix composites reinforced with 10 wt% and 20 wt% of hard titanium-molybdenum carbides ($Ti_{1-x}Mo_xC$), featuring varying molybdenum contents (x = 0.05, 0.15, 0.20). The composites were fabricated using the spark plasma sintering (SPS) technique, with selected consolidation parameters identified through experimental optimization. The starting powder blends consisted of microcrystalline titanium and nanocrystalline (Ti,Mo)C, the latter synthesized via the sol-gel method. Structural characterization of the sintered composites was performed using X-ray diffraction (XRD), while their microstructure was examined via scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The composites, characterized by near-full densification, were reinforced with titanium carbides (TiC) dispersed within a Ti-Mo matrix. Their bimodal microstructure featured nanocrystalline TiC particles located at grain boundaries and embedded within micro- and submicron-sized titanium carbide crystallites.

Keywords: ctitanium-molybdenum carbide, titanium matrix composites, spark plasma sintering,

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SEM and EDX Study of Zinc-Magnesium Phosphate Coatings on Mild Steel Surfaces

Tsvetelina LIUBENOVA[1,*], Dimka FACHIKOVA[1]

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

[*]tsvetelina.liubenova@uctm.edu

Abstract. Magnesium phosphating is a relatively new treatment of metal surfaces, which can replace the traditional zinc phosphate bath. The advantages of using magnesium phosphating preparations include: easy preparation, lower prices compared to other phosphate baths, obtaining coatings with good corrosion resistance and adhesion. The work presents a complex study of the kinetics of the formation of chemically obtained thin phosphate films on mild steel surfaces. The mass/thickness of the films was determined by means of gravimetric measurements under the following conditions: concentration of the working solutions 5, 10, 15 and 20 % vol.; duration of the process 1, 5, 10, 15 and 20 min; temperature 20, 40, 60 and 80°C. The elements that make up the coatings were determined by EDX analysis. The morphology and topography of the obtained surfaces were investigated by sccaning electron microscopy (SEM). Potentiodynamic polarization method was used to determine the corrosion resistance and protective ability of the coatings.

Keywords: magnesium phosphate, coatings, corrosion, mild steel.

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Corrosion and Electrochemical Behavior of Advanced Titanium Alloys Suggested as Biomedical Materials

Dimka FACHIKOVA[1,*], Tatyana GEORGIEVA[1], Gergana ILIEVA[1], Andriana SURLEVA[1]

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

[*]dimkaivanova@uctm.edu

Abstract. Titanium (Ti) and its alloys are widely used for biomedical applications because they possess a unique combination of very important properties such as high specific strength, high corrosion resistance and good biocompatibility. It is well known that the corrosion and electrochemical properties of titanium alloys depend on several factors such as alloy composition and microstructure. This work presents the results obtained in the study of advanced titanium alloys as a materials for the fabrication of implants. The tests were carried out in lactated Ringer's infusion solutions, at different pH values and a temperature of 37°C. A three-electrode glass cell was used in open-air conditions. The following electrochemical methods were used: cyclic potentiodynamic polarization method and open circuit potential (OCP) measurement. The nature of the corrosion attack was determined by optical and scanning electron microscopy (SEM). The surface of the samples was also examined by EDX analysis to determine the nature of the corrosion products.

Keywords: biomaterials, titanium alloys, corrosion behavior.

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Acknowledgement: The financial support of the Bulgarian National Science Fund throughout the project KP06 DOO2/07.12.2023 Cool&SmartTit “A new generation of metallic biomaterials as health solution for a sustainable life” in the frame of the ERANET, ERA-Mine3 program of EU is highly acknowledged.

Structure and Optical Characteristics of Glasses in the TeO_2-BaO-Bi_2O_3-B_2O_3 and GeO_2-BaO-Bi_2O_3-B_2O_3 Systems

Tina TASHEVA[1,*]

[1]Department of Silicate Technology, University of Chemical Technology and Metallurgy, 8 Kliment Ohridski blvd., 1797 Sofia, Bulgaria

[*]tina.tasheva@uctm.edu

Abstract. Glasses containing TeO_2, GeO_2, Bi_2O_3, B_2O_3 are characterized by outstanding properties and applications in various scientific and technological fields such as optoelectronics, linear and nonlinear optics, informatics, communications, spectroscopy, medicine, etc. The present study is focused on the synthesis and structural investigation of glasses in the TeO_2-BaO-Bi_2O_3-B_2O_3 and GeO_2-BaO-Bi_2O_3-B_2O_3 systems. Glasses were synthesized via the melt-quenching method, and the amorphous nature of their structure was verified using powder X-ray diffraction (PXRD). The experimental densities of the samples were measured by Archimedes' principle using an analytical balance equipped with a density kit for solids using distilled water as immersion liquid. The molar volume and oxygen packing density were estimated. Electronic polarizability is a key parameter for the design and control of many properties of glasses, such as refraction, electro-optical effect, ferroelectricity, optical nonlinearity, dielectric properties, etc. In this regard, the electronic polarizability was estimated by the Polarizability approach. The structure of the glasses was investigated by UV-VIS, FTIR and Raman spectroscopy. The refractive index of the glasses was measured by ellipsometry. Correlations between the structure and the optical properties were made.

Keywords: tellurite glasses, germanate glasses, electronic polarizability, refractive index.

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Cold Sintered Fibres-based Soft Magnetic Composites

Bogdan Viorel NEAMTU[1,2,*], Traian Florin MARINCA[1,2], Florin POPA[1,2], Mircea NASUI[3], Nicoleta LUPU[4], Ionel CHICINAS[1,2]

[1]Technical University of Cluj-Napoca, Materials Science and Engineering Department, 103-105, Muncii Avenue, 400641, Cluj-Napoca, Romania
[2]EUT+ Institute of Nanomaterials and Nanotechnologies-EUTINN, European University of Technology, European Union
[3]Center for Superconductivity, Spintronics and Surface Science, Technical University of Cluj-Napoca, Memorandumului Street, no 28, 400114, Cluj-Napoca, Romania
[4]National Institute of Research & Development for Technical Physics, Iasi, Romania

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

Abstract. Currently, over 5% of global electricity consumption is lost as energy dissipation in devices such as transformers. Reducing these losses, which would have a positive environmental impact, can be achieved through the development of new materials with improved electromagnetic properties. Soft Magnetic Composites (SMCs) represent a new class of materials engineered to combine the key benefits of traditional soft magnetic materials namely, the high electrical resistivity of ferrites and the high saturation induction and permeability of electrical steels. SMCs are typically produced via powder metallurgy, involving ferromagnetic particles coated with a dielectric layer and subsequently compacted. Recently, a novel approach has emerged: designing SMCs using ferromagnetic fibres instead of powders, resulting in Fibre-based Soft Magnetic Composites. This innovation significantly enhances the electromagnetic properties compared to conventional SMCs and will be the main focus of the presentation.

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

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Structural Characterization of Ti/B4C/(±Ni) Composite Powders Obtained by Mechanical Milling

Argentina Niculina SECHEL[1,*], Călin-Virgiliu PRICA[1], Florin POPA[1], Traian Florin MARINCA[1], Bogdan Viorel NEAMTU[1]

[1]Materials Science and Engineering Department, Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, 103-106 Muncii Ave, 400641 Cluj-Napoca, România

[*]niculina.sechel@stm.utcluj.ro

Abstract. Titanium-based composites discontinuously reinforced with titanium carbide (TiC) and titanium boride (TiB), obtained by in-situ teghniques, present a series of properties that make them useful in various fields of industry. During the reactive sintering of mixtures of titanium powders with boron carbide (B_4C), an exothermic reaction occurs, and the result is formation of titanium carbide and titanium boride in the titanium matrix. The complete development of this reaction requires high sintering temperatures (~1400°C) [1]. The main goal of the research is the preparation of mechanically and chemically activated composite powders in order to obtain the Ti/(TiC+TiB) composites at lower sintering temperatures. For this purpose, the composite powders of the Ti/B_4C/(±Ni) type were obtained, in the molar ratio Ti:B_4C=5:1 and Ti:B_4C:Ni=6:1:1, respectively, by mechanical milling (MM) in a high-energy planetary ball mill, up to 7 hours. The morphological and structural characteristics of composite powders were determined by laser particle size analysis, scanning electron microscopy with energy-dispersive X-ray spectrometry and X-ray diffraction.

Keywords: titanium matrix composites, mechanical milling, composite powders, microstructures.

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Acknowledgement: This work was supported by the “Ti/(TiB+TiC) type composites obtained by reactive sintering” grant funded by the National Grant Competition - GNaC ARUT 2023.

Physico-Chemical Properties and Structural Characterization of Iron Oxide Containing Glasses

Tina TASHEVA[1,*], Ruzha HARIZANOVA[1], Irena MICHAILOVA[1]

[1]University of Chemical Technology and Metallurgy, 8 Kliment Ohridski blvd., 1797 Sofia, Bulgaria

[*]tina.tasheva@uctm.edu

Abstract. Glasses are synthesized by utilizing the transitional melt-quenching technique in the system (100-x)(0.16Na_2O/0.10CaO/0.74SiO_2)/xFe_2O_3, x = 5 ÷ 20 mol %. For concentrations of the Fe_2O_3 ≤ 15 mol%, glasses are formed while the sample with 20 mol % crystallizes spontaneously during cooling the melt. The densities of the prepared materials are determined and the main physico-chemical characteristics, i.e. molar volume, oxygen-packing density and number of the oxygen ions is estimated. The X-ray diffraction analysis on the glass-crystalline sample shows the precipitation of magnetite. The microstructure of the glass-crystalline sample is studied by optical microscopy and scanning electron microscopy and the existence of two types of iron-rich crystals corresponding to magnetite and hematite is detected. The refractive indices are determined by the Becke line method and are in the 1.567- 1.639 range, i.e. increase with increasing Fe_2O_3 concentration. The structure is characterized by using Fourier-transformed Infra-red spectroscopy. The presence of symmetric stretching, asymmetric stretching and bending vibrations of Si-O-Si is detected and attributed to the occurrence of SiO4 tetrahedral units with varying numbers of nonbridging oxygens. Furthermore, the increasing Fe_2O_3 concentration leads to the occurrence of Fe-O-Si bonds indicating the glass network depolymerization due to Fe_2O_3 addition.

Keywords: soda-lime-silica glass, transition metal oxides, electron microscopy, IR spectroscopy.

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Optimizing Cement Mortar Properties with Partial Sand Replacement by Copper Slag

Afikah RAHIM[1,*], Ahmad Farhan MOHAMAD ZAWAWI[1], Nordiana MASHROS[1], Muhammad Farhan ZOLKEPLI[1], Nor Zurairahetty MOHD YUNUS[1], Khairul Azlan MUSTAPHA[2,8], Thian Lai GOH[3], Nurul Masyiah Rani HARUSI[4], Badrul A. ALAM[5], Hamzah HUSSIN[6], Junhui MOU[7]

[1]Department of Geotechnical and Transportation Engineering, Faculty of Civil Engineering, Universiti Teknologi Malaysia,81310 Johor Bahru, Malaysia
[2]Department of Geology, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[3]Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Selangor, Malaysia
[4]Departemen Teknik Lingkungan, Fakultas Teknik, Kota Makassar, Sulawesi Selatan, Indonesia
[5]Department of Petroleum & Mining, Faculty of Civil Engineering, Military Institute of Science and Technology, Dhaka, 1216 Bangladesh
[6]Department of Geoscience, Faculty of Earth Science, Universiti Malaysia Kelantan, Jeli, Kelantan, Malaysia
[7]National Engineering Research Center for Coal & Gas Control, China University of Mining & Technology, Xuzhou 221008, PR China
[8]Department of Metallurgy and Materials Engineering, Katholieke Universiteit Leuven, Kasteelpark Arenberg 44, B-3001 Leuven, Belgium

[*]afkahrahim@utm.my

Abstract. This paper presents results from an experimental investigation carried out to study the potential use of copper slag as fine aggregates on the strength of cement mortar. Mortar mixtures were prepared using different proportions of copper slag as partial replacement of fine aggregates. The percentage of copper slag added by weight ranged between 10-25% of sand used in mortar. Mortars of 40x40x160mm (width, height, length) and curing times of 7 and 28 days were evaluated for density, compressive strength, and flexural strength. The results indicate that there is an increase in the mortar density of nearly 6% with the increase of copper slag content, whereas the workability increased slightly with increases in copper slag percentage. The results obtained from cement mortars revealed that all mixtures with different copper slag proportions yielded higher compressive and flexural strength than that of the control mixture. There was around 47% and 44% improvement in the compressive and flexural strength of mortar with 25% copper slag substitution in comparison with control mixtures. This study proved that the uses of copper slag up to 25% can be used as replacement of sand to obtain good strength of mortar. Thus, the use of copper slag in mortar presents a viable alternative for partial replacement of sand.

Keywords: copper slag, sand replacement, cement mortar, strength.

Morphology and Mechanical Properties of Thermoplastic Starch Biocomposite Films Incorporating Commercial Clay and Omarama Clay

Haroon HAIZA[1,*], Azlin Fazlina OSMAN[1,2],
Segar ARAVINRAJ[1], Rao KISHAN[1,]
Sinar Arzuria ADNAN[1,2], Syazwani Mahmad PUZI[1]

[1]Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), Arau, 02600, Perlis, Malaysia
[2]Biomedical and Nanotechnology Research Group, Centre of Excellence Geopolymer and Green Technology (CegeoGTech), Universiti Malaysia Perlis (UniMAP), Arau, 02600, Perlis, Malaysia

[*]haizaharoon@unimap.edu.my

Abstract. In this work, three types of filler were introduced into thermoplastic starch (TPS) matrix to form Omarama clay (OC), Commercial clay Russia (CCR) and Commercial clay Malaysia (CCM) biocomposites. TPS biocomposites were prepared at different clay loadings (0.5 g,1 g, 2 g, 3 g, 4 g and 5 g) and by using 3 different forms of clays sonicated Omarama clay (SOC), sonicated commercial clay Russia (SCCR) and sonicated commercial clay Malaysia (SCCM) via the solvent casting technique. The effects of clay loading and sonication process on the mechanical properties of the TPS biocomposites were analyzed using tensile and tear tests. The chemistry aspect of the TPS biocomposites was analyzed using Fourier transform infrared spectroscopy (FTIR) and X-Ray Diffraction (XRD) analysis. According to the mechanical data, biocomposites with a low loading of clay (1 g, 2 g and 3 g) possess greater tensile and tear properties as compared to the biocomposites with a high loading of clay (4 g and 5 g). Furthermore, it is also proved that the OC biocomposites have better mechanical properties when compared to the CCR and CCM biocomposites. Reduction in the clay particle size upon the sonication process assisted in its dispersion and distribution throughout the TPS matrix. Thus, this led to the improvement of the tensile and tear properties of the biocomposites. Based on the findings, it is proven that the sonication process is a simple yet beneficial technique in the production of the TPS-clay biocomposites with improved tensile and tear properties for use as packaging film.

Keywords: biocomposites, thermoplastic starch, Omarama clay, packaging film, mechanical properties.

Thermal and Microstructure Properties of Transient Liquid Phase Sintering Sn-10Cu Solder Paste on Different Surface Finish

Rita MOHD SAID[1,2,*], Mohd Arif Anuar MOHD SALLEH[1,2], Norainiza SAUD[1,2], Nur Syahirah MOHAMAD ZAIMI[1,2], Siti Farahnabilah MUHD AMLI[1,2], Flora SOMIDIN[1,2], Dewi Suriyani CHE HALIN[1,2]

[1]Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[2]Center of Excellence Geopolymer & Green Technology (CeGeoGTech), Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), Taman Muhibbah, 02600 Jejawi, Arau, Perlis, Malaysia

[*]rita@unimap.edu.my

Abstract. In this paper, the effect of different surface finish on the thermal and microstructure of Sn-10 Cu Transient Liquid Phase Sintering (TLPS) solder paste was investigated. The Copper-Organic Solderability (Cu-OSP) preservative and Electroless Nickel Immersion Gold (ENIG) are used as substrate surface finish. The thermal behavior was determined using a Differential Scanning Calorimeter. Then, the microstructure of the bulk solder area and the interfacial metallic compound are studied using a Scanning Electron Microscope (SEM). It was found that the thermal properties for the soldered sample on ENIG did not alter much either melting point or pasty range value from OSP soldered, provided the concentration of copper is the same. For Sn-10Cu, both substrates result in similar bulk microstructure morphology. In addition, ENIG joints give more needle-like and refined IMC.

Keywords: Sn-10Cu, transient liquid phase sintering, microstructure, surface finish.

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Thermal Resilience of Eco-Binary Mortar: An Experimental Study of High-Temperature Exposure

Rohaya Abdul MALEK[1,2,*], Nadia KAMARUDDIN[3], Siti Hawa Mohamed SALLEH[1,4], Salmie Suhana Che ABDULLAH[1,2], Gooven A/L SUBRMANIAM[5], Boonlom THARVORNYURTIKARN[6]

[1]Faculty of Chemical Engineering, Universiti Malaysia Perlis (UniMAP), Malaysia
[2]Center of Excellent Frontier Materials Research, 01000 Seriab, Perlis, Malaysia
[3]School of Real Estate and Building Surveying, College of Built Environment, Universiti Teknologi MARA (UiTM), Shah Alam, Selangor, 40450, Malaysia
[4]Center of Excellent Geopolymer and Green Technology, Taman Muhibbah, Malaysia
[5]Infineon Technologies (Kulim) Sdn. Bhd, Infineon Plant, Lot 10 & 11, Jalan Hi-Tech 7, Taman Kulim Hi-Tech, 09000 Kulim, Kedah, Malaysia
[6]National Metal and Materials Technology Center, Thailand Science Park, Pathumthani 12120, Thailand

[*]rohayamalek@unimap.edu.my

Abstract. Concrete or mortars exposed to high temperatures impact their strength and durability. One of the strategies to overcome this issue is replacing cement with other alternative pozzolanic materials. In this study, the non-beneficial agricultural waste, namely Rice Husk Ash (RHA), has high silica content under controlled burning conditions, making it appropriate to be used as a partial replacement in mortar. The addition of RHA ranges from 5 to 20 wt.% has significantly influenced the appearance of mortars as they perform darker grayish color as the amount of RHA increases. Unexpectedly, this study revealed that greater compressive strength was obtained, almost double the value for 5 wt.% addition of RHA followed by 10 and 15 wt.% addition of RHA, respectively. However, the addition of 20 wt.% RHA was not a preferable mixture as it achieved only 12.49 MPa of compressive strength, which is below the conventional mortar. Due to high-temperature exposure up to 1,093°C, the process influenced the moisture content in the cement paste. It changed the appearance of the sample into whitish-gray color as well as their physical and residual mechanical properties. All samples recorded relative strength values between 0.35 and 0.16. All these findings correlate with the thermal analysis conducted on all samples. Overall, the samples started to evaporate the free water contained in the cement, which passed at a temperature of 82 to 140°C, followed by the decomposition of $Ca(OH)_2$ at 445 to 454°C. It can be concluded that 5 wt.% of RHA addition provided reasonably good properties in comparison to other mixtures. This study exhibited that the consumption of these economical and feasible agricultural waste materials is acceptable to be implemented in the concrete industry and thus bearable to solving dumping and environmental issues.

Keywords: rice husk ash, supplementary cementitious materials, pozzolanic materials, high temperature mortar.

Effect of Sodium Hydroxide Molarities on the Development of Granite Ash Based Geopolymer Paste

Muhammad Ikhmal Alif ABDULLAH[1], Alida ABDULLAH[1,2,*], Mohd Mustafa Al Bakri ABDULLAH[2,3], Rafiza ABDUL RAZAK[2,4], Dewi Suriyani CHE HALIN[2,3], Petrica VIZUREANU[5,6], Mugilan A/L ANANTHAN[1]

[1]Faculty of Mechanical Engineering & Technology, Kampus Tetap Pauh Putra, Universiti Malaysia Perlis, 02600 Arau, Perlis, Malaysia
[2]Centre of Excellent Geopolymer & Green Technology (CeGeoGTech), Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[3]Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[4]Faculty of Civil Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[5]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iaşi, Boulevard D. Mangeron, No. 51, 700050 Iasi, Romania
[6]Academy of Romanian Scientists, 54 Splaiul Independentei St., Sect. 5, Bucharest, Romania
[*]alida@unimap.edu.my

Abstract. As the construction industry advances toward sustainable practices, geopolymer technology emerges as a low-carbon alternative capable of utilizing industrial byproducts. This study investigates the influence of sodium hydroxide (NaOH) molarity on the properties of geopolymer paste synthesized from granite dust, a waste material from granite processing. Geopolymer pastes were prepared using NaOH concentrations of 6 M, 8 M, 10 M, and 12 M, with a fixed sodium silicate ratio (2.5) and a solid-to-liquid ratio of 2.5. Samples underwent dual-stage curing at 29°C and 60°C. Mechanical properties, including compressive strength, density, and water absorption, were evaluated after 28 days. Microstructural and chemical analyses were conducted using Scanning Electron Microscopy (SEM) and X-Ray Fluorescence (XRF). The results revealed that 8 M NaOH yielded the most compact and stable matrix, demonstrating superior mechanical strength and reduced porosity. XRF confirmed the presence of essential aluminosilicates crucial for geopolymerization. This study affirms the potential of granite dust as a viable precursor for geopolymer production, supporting waste valorization and sustainable construction.

Keywords: geopolymer, granite ash, molarity, geopolymer paste

Cu-Cu Material Hybrid Bonding in 3D Stacked Die Configurations: Thermal-Structural Analysis

Yong Jie WONG[1], Mohd Sharizal ABDUL AZIZ[1,*], Chu Yee KHOR[2], Zheng Lin GOH[1], Dewi Suriyani CHE HALIN[3,4]

[1]School of Mechanical Engineering, Engineering Campus, Universiti Sains Malaysia, 14300 Nibong Tebal, Seberang Perai Selatan, Penang, Malaysia
[2]Faculty of Mechanical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia.
[3]Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[4]Centre of Excellent Geopolymer & Green Technology (CeGeoGTech), Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia

[*]msharizal@usm.my

Abstract. This study investigates the thermal and mechanical aspects of 3D stacked die configurations employing copper-copper (Cu-Cu) material hybrid bonding under thermal cycling conditions, which is critical for semiconductor device reliability. The research uses Ansys simulations with Thermal-Structural Coupling, exploring temperature distribution, thermal strain, and Von Mises stress across varying Cu-Cu hybrid bonding heights. The findings reveal uniform heat transfer throughout the thermal cycles, with significant stress concentrations at the corner bonding interfaces. Reducing the Cu-Cu hybrid bonding height from 0.025mm to 0.017mm effectively mitigates thermal strain and stress, with the 0.017mm height proving optimal for minimizing thermal and mechanical effects. This research offers essential insights for enhancing semiconductor packaging reliability, addressing industry demands for energy-efficient, compact devices, and advancing innovation in semiconductor engineering.

Keywords: copper-copper material hybrid bonding, electronic packaging reliability, semiconductor interconnects, thermal-mechanical stress analysis, wafer-level 3d integration.

SECTION 2

PROCEDURES AND TECHNOLOGIES FOR MATERIALS ENGINEERING

Biocompatibility Enhancement through Surface Modification of Metallic Biomaterials and Titanium Alloys

Camilo ZAMORA-LEDEZMA[1,2,*]

[1]Escuela de Ingeniería, Arquitectura y Diseño, Universidad Alfonso X el Sabio (UAX).
Avenida de la Universidad 1, 28691 Villanueva de la Cañada, Madrid, Spain
[2]Biomedical Research Unit (UIB-UAX), Universidad Alfonso X el Sabio (UAX).
Avenida de la Universidad 1, 28691 Villanueva de la Cañada, Madrid, Spain

[*]camilza@uax.es

Abstract. Metallic biomaterials, particularly titanium alloys, are crucial in biomedical applications due to their excellent mechanical properties and biocompatibility. However, their bioinert nature can limit tissue integration, making surface modification essential for enhancing biocompatibility. In this talk, it will be presented innovative strategies for enhancing the biocompatibility of metallic biomaterials, with a focus on titanium alloys. It will be discussed from the general biomaterials concepts, followed by the properties and applications of titanium alloys, and various surface modification techniques to improve their biological interaction. Finally, preliminar results on the use of Kokubo revisited methodology combined with NaOH treatments, and heat treatments, to enhance the biocompatibility of tailored medical grade Ti-alloys through apatite formation will be shown. These findings demonstrate the potential of these methods to improve osseointegration and tissue compatibility, offering promising advancements in biomedical implant technology.

Keywords: biomaterials, titanium alloys, surface modification.

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Improving IT Projects by Using an Integrated Risk Management Model to Navigate Complexity

Nicoleta Madalina STAN[1], Aurel Mihail TITU[2,3,*], Marcin NABIALEK[4]

[1]National University of Science and Technology POLITEHNICA Bucharest, Faculty of Industrial Engineering and Robotics, Splaiul Independenţei nr. 313, 6th District, Bucharest, Romania
[2]Lucian Blaga University of Sibiu, 10 Victoriei Street, Sibiu, Romania
[3]Academy of Romanian Scrientists, 3 Ilfov Street, Bucharest, Romania
[4]Częstochowa University of Technology, Department of Physics, Armii Krajowej 19 Av., 42-200 Częstochowa, Poland

[*]mihail.titu@ulbsibiu.ro

Abstract. This paper presents an innovative integrated risk management model designed to empower IT projects by effectively navigating the multifaceted challenges they face. The model synthesizes traditional risk management practices with contemporary methodologies, including agile frameworks and systems thinking, to create a holistic approach that addresses both technical and organizational dimensions of risk. The integrated model introduces a structured yet flexible framework that encompasses risk identification, assessment, response planning, and monitoring, tailored specifically for the complexities inherent in IT projects. This paper contributes to the field by providing a practical framework that not only addresses current challenges but also prepares organizations for future complexities in IT project management.

Keywords: risk management, complex it projects, integrated model, project success, stakeholder engagement.

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Improving Environmental Quality by Taking Responsibility and Assessing GHG Emissions

Alexandra-Florina IAMANDII[1], Aurel Mihail TITU[2,3,*], Marcin NABIAŁEK[4]

[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]Academy of Romanian Scrientists, 3 Ilfov Street, Bucharest, Romania
[4]Częstochowa University of Technology, Department of Physics, Armii Krajowej 19 Av., 42-200 Częstochowa, Poland

[*]mihail.titu@ulbsibiu.ro

Abstract. The aim of this paper is to showcase the real emissions of an organization operating in this field, using real data from the rganization. Most similar studies focus on information provided by the equipment and vehicle manufacturers, however this may not necessarily be a very realistic approach, as data regarding specific consumption is not necessarily true in real life scenarios. Thus, this piece of work shall facilitate a better understanding of GHG emissions in such an organization and compare the results with other relevant preexisting studies. Furthermore, this study aims to identify areas for improvement and propose recommendations to lower the amount of GHG emissions.

Keywords: GHG emissions, road freight transport, air pollution, caron footprint, lower environmental impact.

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Comparison of a Numerical 3D Simulation of the Elastic Modulus of Porous Bioceramics with Different Representative Volume Element Sizes

Duarte F. MACEDO[1,*], Mariana B. OLIVEIRA[2], Filipe OLIVEIRA[3], Abílio P. SILVA[1]

[1]Centre for Mechanical and Aerospace Science and Technologies (C-MAST), Universidade da Beira Interior, Rua Marquês d'Ávila e Bolama, 6201-001, Covilhã, Portugal
[2]Department of Chemistry, CICECO – Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
[3]Department of Materials and Ceramics, CICECO – Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal.

[*]duarte.felix.macedo@ubi.pt

Abstract. The design of biomaterials that closely mimic bone has been associated with chemical compositions rich in metal ions, as well as the replication of different levels of physiological porosity, which is fundamental for interconnectivity and subsequent tissue vascularization. This work proposes a methodology for constructing a digital 3D microstructure of tricalcium phosphate (β-TCP) bioceramics doped with metal ions (e.g., Mg^{2+}, Mn^{2+}, Fe^{3+}, Zn^{2+}), with a porosity level of 18.9%, and varying representative volume element (RVE) sizes (7 μm^3, 11 μm^3, 15 μm^3). The study focuses on segmenting two-phase microstructures (dense TCP and pores) and analyzing grain boundaries, area, and grain size distribution using ImageJ software and the Schwartz–Saltykov method. The numerical model used to predict elastic properties was validated experimentally through the Impulse Excitation Technique (IET). Numerical simulations of the elastic modulus showed a reduction in error relative to experimental values as RVE size increased (+9.8%, -3.6%, and -3.6%), demonstrating excellent agreement with experimental results for larger RVEs (<5% error). This approach provides a cost-effective and reproducible framework for reconstructing 3D microstructures, enabling accurate property prediction and optimization of β-TCP ceramics for biomedical applications.

Keywords: numerical Simulation; digital twin; tricalcium phosphate; elastic modulus.

Acknowledgement: This work was supported by FCT-Fundação para a Ciência e a Tecnologia, I.P./MCTES, through national funds (PIDDAC), within the scope of the Unit I&D: C-MAST (Centre for Mechanical and Aerospace Science and Technology), Projects UIDB/00151/2020 and UIDP/00151/2020. Also, this work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MCTES (PIDDAC). M.B.O acknowledges national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., under the Scientific Employment Stimulus - Institutional Call - CEECINST/00013/2021. D.F. Macedo also acknowledges his PhD fellowship from FCT (2022.14478.BD).

Core Losses in the Remagnetization Process of Soft Amorphous Fe Based Alloys

Marcin NABIAŁEK[1], Bartłomiej JEŻ[2,*]

[1]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, Al. Armii Krajowej 19, Czestochowa 42-201, Poland
[2]Czestochowa University of Technology, Faculty of Mechanical Engineering, Al. Armii Krajowej 19c, Czestochowa 42-201, Poland

[*]bartlomiej.jez@pcz.pl

Abstract. Currently, energy-saving materials are being sought that show less and less electricity consumption. A very important parameter is also its core lossless. Amorphous materials belong to the group of materials in which the phenomenon of magnetostriction is minimized to zero. The measure of total core losses in soft magnetic ferromagnets working as cores in transformers is the area of the dynamic magnetic hysteresis loop. The paper presents the results of tests on remagnetization in amorphous materials with similar chemical compositions. It was shown that the surface of the magnetic hysteresis loop changes with the change of non-magnetic alloy component.

Keywords: bulk metallic glasses, core losses, amorphous alloys, soft magnetic properties.

Experimental Study of Surfacing Quality and Optimal Modes Laser Restoration a Wagon Wheel

Vitaliy SAVINKIN[1], Zaure ZHUMEKENOVA[1,*], Petrica VIZUREANU[2,3], Andrei Victor SANDU[2,3,4,*]

[1]Non-profit limited company "Manash Kozybayev North Kazakhstan university", Pushkin street, 86, Petropavlovsk, Kazakhstan
[2]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iaşi, Boulevard D. Mangeron, No. 51, 700050 Iasi, Romania
[3]Academy of Romanian Scientists, Bucharest, Romania
[4]Romanian Inventors Forum, Str. P. Movila 3, 700089 Iasi, Romania

[*]zhumekenova82@mail.ru, sav@tuiasi.ro

Abstract. It has been established that the hardness and adhesion of the deposited layer, in addition to the key modes (laser beam energy density, laser radiation power, wheel rotation speed, etc.), are influenced by parameters such as exposure time to the surface, distance from the focal plane, and mechanical properties of the steel phase. It is proved that exceeding the distance from the focal plane of more than 80 mm leads to a decrease in the quality of the coating (hardness and adhesion). This means that the established dependencies make it possible to optimize the modes of laser surfacing while restoring the mechanical and geometric characteristics of the gondola wheel. The optimal microhardness values of 5000 MPa are achieved due to the optimal transition zone of 0.8 – 1.45 mm deposition. High microhardness is achieved with an optimal reasonable distance of 10-15 mm and a surfacing speed of 15 mm/s. A further increase in the transition zone to 1.45 mm does not significantly change the microhardness, and with an increase in thickness to 1.6 mm, the microhardness decreases sharply. Optimal modes of restoring the rolling surface of the wheel and ridge have been established and justified: radiation power 2000...3000 W; surfacing speed 10-15 mm/s; diameter of the radiation focusing spot 1.5...2.5 mm; diameter of the processing laser spot (surfacing distance) – 10-20 mm; energy density of the laser beam - 3·105 W/cm2; distance from the focal plane – 20-100 mm; the mass consumption of surfacing powder is 0.25 g/s. bring your dock.

Keywords: laser surfacing, recovery quality, energy efficient technology, the wagon wheel, phase structure, experiment.

Study of Thermal Proccesings Applied to an Aluminium Alloy

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

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

[*]petrica.vizureanu@academic.tuiasi.ro

Abstract. The paper presents an experimental study about the hardness modifications on cast aluminium alloy, subjected to heat treatments. The alloys come from the recycling of some parts used in automotive industry. The melting was made at 750°C. The heat treatments applied are annealing, quenching solution and artificial ageing.

Keywords: hardness, temperature, melting, parts.

Acknowledgement: This work was supported by Bio-Simtit Grant of the Ministry of Research, Innovation and Digitization, CCCDI – UEFISCDI, project number PN-IV-P7-7.1-PED-2024-0080, within PNCDI IV.

Tribological Characterization of Zn-Zr-Sr Conversion Coatings Deposited on Ti6Al4V

Diana-Petronela BURDUHOS-NERGIS[1], Anca CAZAC[1], Nicanor CIMPOESU[1,*], Marcelin BENCHEA[2], Costica BEJINARIU[1,*]

[1]Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University of Iasi, , 41 "D. Mangeron" Street, 700050, Iasi, Romania
[2]Faculty of Mechanical Engineering, "Gheorghe Asachi" Technical University of Iasi, 43 "D. Mangeron" Street, 700050, Iasi, Romania

[*]nicanor.cimpoesu@academic.tuiasi.ro, costica.bejinariu@yahoo.com

Abstract. In the last years, the improvement of the Ti6Al4V surface characteristics has gained more and more attention. Therefore, the idea of covering the alloy surface with layers obtained by the chemical conversion process is relevant to the biomedical field. In this case, in order to enhance the biocompatibility and osseointegration of the Ti6Al4V, three phosphate layers based on Zn, Zr, and Sr were deposited. The layers have different quantities of Zr and Sr, which led to a different morphology. In this paper, the tribological characteristics of these layers were studied by scratch and microindentation tests. Additionally, an SEM with an EDS detector was used in order to observe the morphology of the Zn-Zr-Sr phosphate layers.

Keywords: tribological characterization, scratch, microindentation, phosphate layers, titanium alloy.

Acknowledgement: This work was supported by a National Research Grants of the TUIASI, project number GNaC 2023_272/2024, Straturi inovative obținute prin conversie chimică pentru îmbunătățirea răspunsului biologic al implanturilor din titan (BioTiC) - Innovative layers obtained through chemical conversion to improve the biological response of titanium implants (BioTiC).

Innovative Coating Technologies for Enhanced Ballistic Material Performance

Georgiana GHISMAN[1], Daniela BURUIANA[1,*], Tudor Viorel TIGANESCU[2], Nicoleta BOGATU[1]

[1]Interdisciplinary Research Centre in the Field of Eco-Nano Technology and Advance Materials CC-ITI, Faculty of Engineering, "Dunarea de Jos" University of Galati, 47 Domneasca Street, 800008 Galati, Romania
[2]Military Technical Academy "Ferdinand I", 39-49 George Cosbuc Boulevard, 050141 Bucharest, Romania

[*]daniela.buruiana@ugal.ro

Abstract. As the demand for high performance personal protection increases, the development of advanced materials for bulletproof vests becomes essential. This study investigates how protective coatings influence the properties of ballistic materials, with a focus on Kevlar, a widely used aramid fiber known for its strength and durability. By applying nanostructured coatings such as carbon nanotubes (CNT), graphene, zinc oxide (ZnO), and nano-clays using techniques like dip coating, chemical vapor deposition (CVD), or physical vapor deposition (PVD), significant improvements are achieved in tensile strength, impact resistance, chemical stability, and thermal behavior. The integration of these coatings with traditional base materials (nylon, polyester, ceramics, metal alloys) enhances the vest's ability to withstand ballistic impacts while maintaining low weight, flexibility, and comfort. The results indicate that such multifunctional coatings not only reinforce protective capabilities but also increase the service life of the vests, making them more efficient and reliable in both civilian and military applications.

Keywords: innovative coatings, impact resistance, material performance, durability.

Design Optimization and Mechanical Assessment of a Cryogenic Liquid Oxygen Storage System for Industrial Applications

Marian Cristian STAICU[1], Daniela BURUIANA[1,*], Viorica GHISMAN[1], Gabriel Bogdan CARP[1]

[1]Interdisciplinary Research Centre in the Field of Eco-Nano Technology and Advance Materials CC-ITI, Faculty of Engineering, "Dunarea de Jos" University of Galati, 47 Domneasca Street, 800008 Galati, Romania

[*]daniela.buruiana@ugal.ro

Abstract. This paper presents the development and evaluation of a cryogenic storage system designed for liquid oxygen in industrial settings. The system comprises an inner and outer vessel, optimized to ensure high thermal insulation and reduce heat transfer, thereby enhancing the safety and efficiency of liquefied gas storage. A vaporizer is integrated to maintain thermodynamic balance and support phase control during the transfer process. The mechanical performance of the inner tank is examined through cold stretching tests, simulating conditions beyond standard operating parameters to evaluate structural resilience. Experimental results reveal stable plastic deformation behavior, confirming the integrity of the design under increased loading. Finite element analysis further validates the experimental data, supporting the selection of materials and construction methods. The findings demonstrate the viability of the prototype for reliable industrial use.

Keywords: structural integrity, finite element analysis, prototype evaluation.

Effects of SLM Printing Parameters and Heat Treatments on the Corrosion Resistance of a Biocompatible Co-Cr-W Alloy

Mihai POPA[1,*], Ramona CIMPOEȘU[1], Elena MATCOVSCHI[1], Constantin BĂCIU[1,*]

[1]Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University of Iasi, Blvd. Dimitrie Mangeron 71 A, 700050 Iasi, Romania.

[*]mihai.popa@academic.tuiasi.ro, constantin.baciu@academic.tuiasi.ro

Abstract. SLM (Selective Laser Melting) is one of the most common additive manufacturing technologies, appreciated for its precision and accuracy in the fabrication of complex tridimensional parts from metallic powders, by tridimensional computer-assisted design (CAD-3D). The parts fabricated by this method have a remarkable wear and corrosion resistance, high hardness and good fiability. The SLM technology has been applied in various fields, such as automotive industry, the aerospatial sector and the medical field (for bone prostheses and dental applications). The process involves the total melting of the metallic powder by means of a laser beam, the energy and power of which can be controlled. Subsequently, the material solidifies from the liquid phase and the physical-chemical and mechanical characteristics of the finished products are influenced by the technological parameters used in the process. The heat treatments applied to the SLM-processed parts, especially those for medical applications, are meant to reduce internal stresses, to equalize the microstructure, with favorable effects on the material's corrosion resistance and biocompatibility. In this way, the exploitation sustainability of the implants and medical devices, SLM-processed from Co-Cr-W alloy powders, can be improved.

Keywords: SLM (Selective Laser Melting), metallic powders, corrosion.

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Heat Treatment Effects on the Structure and Properties of SLM Printed Co-Cr-W Alloy

Mihai POPA[1], Monica-Nicoleta LOHAN[1],
Bogdan ISTRATE[1], Leandru-Gheorghe BUJOREANU[1,*]

[1]Faculty of Materials Science and Engineering, "Gheorghe Asachi" Technical University of Iasi, Blvd. Dimitrie Mangeron 71 A, 700050 Iasi, Romania

[*]leandru-gheorghe.bujoreanu@academic.tuiasi.ro

Abstract. The post-processing heat treatment, applied to the alloys additively manufactured by selective laser melting (SLM – Selective Laser Melting), is meant to reduce the internal stresses induced during 3D printing and to cause structural changes that alter the properties, thus increasing the quality of the final product. The paper emphasizes the changes produced in the microstructure of a SLM printed Co-Cr-W alloy, after different heat treatments meant to control the microscopic structure in such a way as to enhance the physical-mechanical properties of the alloy. The results have proved that the microstructure of the Co-Cr-W alloy, formed during SLM process has better mechanical properties, biocompatibility and corrosion resistance as compared to classical casting, which creates better perspectives for clinical applications. A direct relationship was emphasized between the applied heat treatments, the microstructure of SLM printed Co-Cr-W alloy and its performance.

Keywords: SLM – Selective Laser Melting, 3D printing, Co-Cr-W alloy.

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Shear Performance of Hollow Clay Block Masonry Infill Walls with Precompression

Roland-Tibor BARTA[1,*], Attila PUSKAS[1]

[1]Faculty of Constructions, Technical University of Cluj-Napoca, Baritiu Street, RO-400027 Cluj-Napoca, Romania

*barta.ti.roland@student.utcluj.ro

Abstract. Masonry infill walls became more and more popular in the second half of the 20th century with the widespread reconstruction of Europe after WWII due to their cost-effectiveness, durability, and construction speed, yet there is a lack of studies on their behavior to in-plane lateral forces. In order to accurately assess their structural role in a building, it is essential to fully understand their behavior, particularly because cracks are likely to occur when they approach their limit of resistance. The aim of this study is to investigate the shear response and failure mode of a masonry infill wall made of hollow clay blocks under a precompression force. Brick triplet shear tests were carried out in order to calibrate the interaction model between the bricks. An analysis is conducted using a finite element software, Abaqus, with a simplified micro model approach, using a surface-based cohesive model for the interaction surface between bricks. Furthermore, the numerical simulations were compared to an experiment and manual calculations in compliance with Eurocode-6. The goal of this paper is to achieve a better prediction of shear performance, rigidity, and failure modes of masonry infill walls and to explore potential consolidation methods for structures that incorporate masonry walls. Ultimately this can also improve the understanding of the energy dissipation mechanisms of these walls during an earthquake.

Keywords: masonry infill wall, hollow clay block, simplified micro-model, Finite Element Method

Influence of Laser Pulse Design on Clad Layer Hardness and Geometrical Characteristics

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

[1]Department of Materials Engineering and Welding, Transilvania University of Brașov, 29 Eroilor Street, 500036, Brașov, Romania

[*]dan.cuculea@unitbv.ro

Abstract. In these days, laser cladding has become the most used technology in repairing of worn surfaces or creating new surfaces through rapid prototyping process. This technology provides more qualitative layers as well as high precision. This study is an experimental one which is looking towards optimizing one-step laser cladding process and its objective is enhancing the quality of the deposited layers by investigating the key-parameters, such as laser power, depositing velocity, cladding rate and the correlation between these parameters. Wang et al. has researched the influence of the laser pulse form on rail steels using Taguchi method for height, width and hardness of the cladded layer. The results has validated the major influence of the laser pulse profile on the height. Also, by varying the speed rate and the laser power, the geometrical characteristics and mechanical properties are influenced by the laser pulse design [1]. The experimental tests has been carried out by a pulsed laser Trumpf TruPulse 556 with a co-axial cladding module with Ni-based powders on a S355MC substrate.

Keywords: pulsed laser, laser cladding, dilution, S355MC.

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Optimization of Laser Cladding Technology in NAB Marine Propeller Reconditioning

George Ciprian IATAN[1,*], Dan CUCULEA[1], George ARDELEAN[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. Materials used in the marine environment are generally selected for their elevated performances within an aggressive operational context. This is also the case of the marine propellers, extensively manufactured through cast Nickel-Aluminum Bronze (NAB), due to their favorable mechanical properties and corrosion resistance. In spite of that, under the combined effect of the erosional cavitation and corrosion, marine propellers are prone to degradation.1 This study is focused on maximizing the efficiency of pulsed laser cladding through synchronous powder feeding, while shaping this technique as a sustainable reconditioning approach for NAB propellers. Aiming to obtain a defect free coating with good bonding and elevated mechanical characteristics1,2, a pulsed wave laser (Trumpf TruPulse 556) and a cladding head (Precitec WC 50) were used for deposing Cu matrix alloy powders. One of the main challenges is represented by overcoming the high reflectivity of the copper matrix, present in both the base material of the propeller and in the powders. This is significantly decreasing the absorption of the laser energy. However, good quality deposition was obtained through optimizing the process parameters of the pulsed laser. The resulted coatings were characterized by optical microscopy and electron microscopy. It was noticed quasi-uniform deposition with no discernable cracks or porosity. Furthermore, microhardness values revealed transition regions in the coating layer. The study confirms laser cladding with pulsed lasers as being a valuable and efficient surface engineering method in reconditioning damaged marine propellers. Throughout the obtained results, the path for future studies aiming to also extending the service life of cooper based marine components is opened.

Keywords: laser cladding, Nickel-Aluminum Bronze, marine propeller.

Mechanical Finishing of the APS-Coated Surfaces

Daniel CRISTISOR[1], Daniela Lucia CHICET[2,*], Adrian STEFAN[1], Bogdan ISTRATE[1], Alina-Corina DUMITRASCU[1], Corneliu MUNTEANU[1,3,*]

[1]Faculty of Mechanical Engineering, Gheorghe Asachi Technical University of Iasi, Blvd. Mangeron, No. 61, 700050, Iasi, Romania
[2]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iasi, Blvd. Mangeron, No. 41, 700050, Iasi, Romania
[3]Technical Sciences Academy of Romania, 26 Dacia Blvd, Bucharest, Romania

[*]daniela-lucia.chicet@academic.tuiasi.ro, corneliu.munteanu@academic.tuiasi.ro

Abstract. Surface quality is crucial in the functionality, durability and visual quality of various engineering and non-engineering products. The surfaces obtained by thermal spray coating provide a multitude of enhancements (wear resistance, corrosion resistance, thermal shock resistance, etc.) but are generally characterised by a high roughness (Ra) of about 3-40 µm [1], due to the manufacturing method. The study presented in this paper addresses and evaluates precisely the possibility of finishing some coatings produced by thermal plasma spraying using Cr_2O_3-based powders alloyed with different percentages of TiO_2. In this paper, the mechanical finishing with abrasive materials has been approached, with the following steps: a) grinding with sand paper with increasing grit (starting from P300 until P 2500 grit size); b) polishing with a 3 µm abrasive diamond suspension solution and c) buffing with 1 µm diamond paste. After each change of grit size of the abrasive material, intermediate measurements of the roughness were made with the Mahr Perthometer to monitor the influence and therefore the efficiency of each accomplished stage. Finally, coating surfaces with an average Ra of 0.168 µm were obtained, with a minimum thickness loss of the deposited coating. It could thus be concluded that mechanical finishing is a feasible method to improve the roughness and thus the quality of plasma spray coatings.

Keywords: APS, Cr_2O_3 – n%TiO_2 coatings, mechanical finishing, roughness

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Surface Engineering of PLA – 3D Printed Parts by Laser Melting

Madalin FARCAS[1], Daniela Lucia CHICET[2,*], Mihai AXINTE[2], Fabian LUPU[1], Bogdan ISTRATE[1], Corneliu MUNTEANU[1,3]

[1]Faculty of Mechanical Engineering, Gheorghe Asachi Technical University of Iasi, Blvd. Mangeron, No. 61, 700050, Iasi, Romania
[2]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iasi, Blvd. Mangeron, No. 41, 700050, Iasi, Romania
[3]Technical Sciences Academy of Romania, 26 Dacia Blvd, Bucharest, Romania

[*]daniela-lucia.chicet@academic.tuiasi.ro

Abstract. Surface engineering of PLA (polylactic acid) 3D-printed parts is an active research area, focusing on improving the functional and aesthetic properties of the additive-manufactured components. The surface quality of PLA parts is significantly influenced by printing process parameters such as layer height, nozzle temperature, printing speed and part orientation. To improve the surface finish, various post-processing methods are used: - Mechanical grinding can reduce roughness, but it is time-consuming and can affect part geometry;- Heat treatments can improve mechanical properties and dimensional stability, but require careful control to avoid distortion;- Chemical treatments, such as exposure to solvent vapours, can smooth the surface, but should be applied with caution to prevent material damage. The application of ceramic, polymer, or metallic coatings can impart additional properties to PLA parts, such as wear resistance, hydrophobicity or electrical conductivity. In this research, the possibility of impregnation with Cr2O3-based ceramic particles of the surface of PLA-3D printed samples by localised laser melting was studied, under the conditions of a 50-80 µm dry powder film applied on this surface. When varying the laser power (from the value of 1.12 W, to the value of 1.28 W and the value of 1.44 W), it was observed that the first variant led to successful impregnation of the powder into the surface layer of the tested PLA samples. Thus, it can be concluded that this method opens new opportunities for improving the surface characteristics of the 3D printed PLA 3D printed parts.

Keywords: 3D printed PLA parts, laser melting, powder impregnation.

Temperature-Dependent Microstructure and Properties of Porous Al_2O_3 Films

Christian GIRGINOV[1,*], Stephan KOZHUKHAROV[2], Neda NEYKOVA[3]

[1]Department of Physical Chemistry, University of Chemical Technology and Metallurgy, 1797 Sofia, Bulgaria
[2]LAMAR Laboratory, University of Chemical Technology and Metallurgy, 1797 Sofia, Bulgaria
[3]Department of Electrotechnology, Ceske vysoke uceni technicke v Praze Fakulta elektrotechnicka, Prague, Czechia

[*]girginov@uctm.edu

Abstract. Porous anodic alumina (PAA) films are functional materials with applications in decorative coatings, anticorrosion layers, catalysis, and sensing devices. These Al_2O_3 coatings are formed under strong electric fields, resulting in a glass-like structure. Anodization temperature plays a critical role in determining their structure and properties. This study examines the influence of anodization temperature on PAA films grown in H_2SO_4 under galvanostatic conditions. AA1050 alloy samples underwent standard pretreatments, followed by anodization at -30°C to +10°C with continuous stirring. Scanning electron microscopy revealed a non-linear variation in average pore diameter (around 6.5 nm) with temperature, while porosity decreased at lower temperatures. Films anodized at lower temperatures exhibited superior corrosion resistance in a model NaCl solution and demonstrated hydrophilic surfaces. These findings emphasize the importance of temperature in optimizing Al_2O_3 films for high-performance coatings and their compatibility with applications involving glass materials.

Keywords: porous anodic alumina, anodization temperature, porosity.

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Double-Sintering of Invar36 Mechanically Alloyed Powders

Calin-Virgiliu PRICA[1,*], Argentina Niculina SECHEL[1], Traian Florin MARINCA[1], Florin POPA[1], Bogdan Viorel NEAMTU[1], Tamas MIKLOS[2], Ionel CHICINAS[1]

[1]Materials Science and Engineering Department, Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, 103-106, Muncii Ave, 400641 Cluj-Napoca, Romania
[2]Naposint Company, Rascruci, 407107 Cluj, Romania

[*]calin.prica@stm.uctm.ro

Abstract. The aim of the paper is characterization of Invar36 compacts obtained by conventional dpuble-sintering of mechanically alloyed (MA) elemental powders. The alloy Invar36, containing 64 % at. Fe and 35 % at. Ni, was first introduced in 1897 by Guillaume.This type of alloy has an extremely low coefficient of thermal expansion (CTE) up to Curie temperature (250 ˚C). The Invar's coefficient of thermal expansion at the ambient temperature is less than 2 × 10^{-6} ˚C^{-1}. The MA was performed in a high energy planetary ball mill (Fritsch Pulverisette 6) using hardened steel vials and balls. The milling process was carried out in an Ar atmosphere. Mechanically alloyed powders were densified by conventional double-sintering in an continuous belt furnace at 1120 °C. The samples were characterized by scanning electron microscopy (SEM) in order to investigation the microstructures. Also, the double sintering efect on Invar36 crystallite sizes has been studied using X -ray diffractometry. Dilatometry measurements were taken by an Ulbricht-Weiss dilatometer. The CTE value of Invar36 conventional double-sintered (α = 0.9 x 10^{-6} °C^{-1}) is very low, up to their Curie temperature.

Keywords: Invar36 alloy, mechanical alloying, double-sintering, coefficient of thermal expansion.

Acknowledgement:
This work was supported by the "Composite materials with a low thermal expansion coefficient, of the Invar/Si_3N_4 type, obtained by spark plasma sintering of mechanically alloyed powders" grant funded by the National Grant Competition - GNaC ARUT 2023.

Soft Magnetic Composite Obtained from Nanosized Al-Permalloy and Hematite Nanoparticles by Reaction Spark Plasma Sintering

Traian Florin MARINCA[1,*], Bogdan Viorel NEAMTU[1], Florin POPA[1], Virgiliu Călin PRICA[1], Ionel CHICINAS[1]

[1]Materials Science and Engineering Department, Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, 103-106 Muncii Ave, 400641 Cluj-Napoca, România

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

Abstract. Permalloy, Ni71.25Fe23.75Al5, classical composition was modified by adding aluminium. The new alloy was synthesized directly in nanocrystalline state by mechanosynthesis starting from elemental powders and we named Al-permalloy. Upon controlling the mechanosynthesis parameters the size and shape of the particles can be controlled. The as obtained metallic particles have been covered by two layers of oxides. The first layer is a mixture of oxides obtained by several techniques and the second layer consists of a hematite iron oxide. This second layer is a quasi-continuous one and has been obtained using 20-40 nm hematite nanoparticles. Soft magnetic composite compacts of permalloy/alumina type have been obtained by reactive spark plasma sintering-SPS of double layered composite particles. Upon sintering the oxides layers react with the metallic core resulting in a continuous matrix of oxides, alumina mainly. This network of oxides offers very good electrical insulation of metallic particles and thus a high electrical resistivity and allows the soft magnetic composite from middle to high frequencies applications with low core losses.

Keywords: permalloy, soft magnetic composite, spark plasma sintering, mechanosynthesis.

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Mechanical and Conductive Properties of Silicone Filled Graphene Electrically Conductive Adhesive (Eca)

Nurin Aisyah AHMAD OMAR[1], Zuliahani AHMAD[1,*], Adzrie BAHARUDIN[1], Rozyanty RAHMAN[2], Solhan YAHYA[1], Wan Izhan Nawawi WAN ISMAIL[1]

[1]Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM) Perlis Branch, 02600 Arau, Perlis, Malaysia
[2]Advanced Polymer Group, Centre of Excellence Geopolymer And Green Technology (CEGeoGTech), Universiti Malaysia Perlis, 02600 Jejawi, Perlis, Malaysia

[*]zuliahani@uitm.edu.my

Abstract. This study examined the preparation of silicone-based graphene electrically conductive adhesive (ECA) with addition of polyethylene glycol (PEG-600) via ultrasonication mixing. Silicone ECA incorporated with various graphene loading (0%, 3%, 5%, 7%, and 9%) as filler to enhance the conductivity of ECA. The obtained ECA was characterized using tensile test, Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) whilst, electrical properties determination was conducted using Electrochemical Impedance Spectroscopy (EIS). The presence and dispersion of graphene in the silicone and PEG-600 was affirmed with the emergence of -OH, CH, C=C, and C=O functional groups proves that the graphene was successfully introduced into the polymer with the -OH peak migrated to a higher strength at optimum value of 7% graphene loading as compared to control sample. The conductivity of the graphene's various loading found optimum value at 9% at 4.87×10^{-6} S/cm attributed to the electron in graphene has a long mean free route, producing a continuous channel that facilitates free electron movement for electrical conduction without interfering with electron-electron interaction or disorder where graphene filled the void as apparent in SEM images. Similar trend was obtained for tensile strength and young modulus at 7%, shown the optimum value at 0.305 MPa and 146.523 MPa respectively before the value decreased as graphene loading increased due to the inherent properties of graphene that have a strong covalent bond between its carbon atoms. The increment was associated with the material's surface contact rises, the chain mobility of silicone-filled graphene decreased, which can also improve the composite's stiffness. This research signifies a successful utilization of graphene and PEG-600 enhanced the conductivity and mechanical properties of ECA.

Keywords: electrically conductive adhesive, silicone, conductivity, mechanical properties, electrochemical Impedance spectroscopy (EIS).

Synergistic Effects of Hybrid Montmorillonite and Graphene Nanoplatelets on the Mechanical, Thermal, and Structural Properties of Epoxidized Palm Oil/Epoxy Composites

Nur Aliaa ZULKEFLI[1], Rohani MUSTAPHA[1,*], Che Mohd Ruzaidi GHAZALI[1], Suriani Mat JUSOH[1], Siti Noor Hidayah MUSTAPHA[2]

[1]Faculty of Ocean Engineering Technology, Universiti Malaysia Terengganu, Kuala Nerus 21030, Terengganu, Malaysia
[2]Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, Kuantan, Pahang 26300, Malaysia

[*]rohani.m@umt.edu.my

Abstract. Vegetable oils (VOs) are promising alternatives to conventional epoxy resins due to their renewability. This study investigates epoxidized palm oil (EPO) in a blend with Diglycidyl Ether of Bisphenol-A (DGEBA) resin, examining synergistic effect of hybrid nanofillers—graphene nanoplatelets (GNPs) at 0.5, 0.75, and 1.0 wt%, and montmorillonite (MMT) at 1.0, 1.5, and 2.0 wt%. Characterization techniques included FTIR, XRD, SEM, mechanical testing (flexural and impact strength), and thermal analysis (DSC and TGA). FTIR confirmed the successful blending of EPO into the resin matrix. Among the formulations, the GNP0.5:MMT1.5 hybrid nanocomposite exhibited the most notable enhancement, with a 37.7% increased in flexural strength (86.31 MPa) and a 9.5% increased in flexural modulus (2.87 GPa), and a 43.5% improvement in impact strength (12.7 kJ/m²). The glass transition temperature (Tg) increased by 20.6%, reaching 67.79 °C, while thermogravimetric analysis (TGA) also revealed enhanced thermal stability.

Keywords: epoxy-epoxidized palm oil blend, graphene nanoplatelets (GNPs), montmorillonite (MMT), mechanical and thermal properties, hybrid nanofillers.

Tunable Synthesis of Nitrogen-Doped Carbon Quantum Dots via Hydrothermal Method Using Factorial Design

Jeefferie ABD RAZAK[1,*], Noraiham MOHAMAD[1],
Wan Putri Najihah ZULKARNAIN[1],
Nurul Ayunni ABDUL LATIFF[2]

[1]Fakulti Teknologi dan Kejuruteraan Industri dan Pembuatan, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, Durian Tunggal, Melaka, Malaysia
[2]Politeknik Merlimau Melaka, KM2.5, Jalan Merlimau-Jasin, 77300, Merlimau, Melaka

[*]jeefferie@utem.edu.my

Abstract. Carbon quantum dots (CQDs), a promising group of carbon-based nanomaterials, are widely recognized for their remarkable photoluminescence, environmental safety, and versatility in surface functionalization. This study presents the green synthesis of nitrogen-doped carbon quantum dots (N-CQDs) using citric acid (derived from local lime) and urea via a hydrothermal method. The primary aim is to investigate and optimize the effects of synthesis parameters such as temperature, reaction time, and precursor ratio, on the structural and optical properties of the N-CQDs. Characterization was carried out using UV-Vis spectroscopy, fluorescence analysis, FTIR, and TEM, while Tauc plot analysis was used to determine band gap values. A 2^3 full factorial design of experiments (DOE) across 11 runs was implemented to identify optimal synthesis conditions. The optimized N-CQDs, with particle sizes ranging from 5 to 10 nm and a band gap around 3 to 6 eV, exhibited strong luminescent behavior. Importantly, this study emphasizes the tunability of N-CQDs' functional properties through controlled hydrothermal synthesis, paving the way for their effective use as multifunctional fillers in nanocomposites to enhance the structural and optical performance across diverse applications.

Keywords: carbon quantum dots, hydrothermal synthesis, tunable.

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Substrate Patterning Effect on the Wetting Behavior and Intermetallic Formation of SnCu Alloy

Nurul Aida Husna MOHD MAHAYUDDIN[1],
Juyana A. WAHAB[1,2,3,*], Mohd Arif Anuar MOHD SALLEH[1,2],
Muhammad Firdaus MOHD NAZERI[1,2,3],
Dewi Suriyani CHE HALIN[1,2]

[1]Department of Materials, Faculty of Chemical Engineering and Technology, Kompleks Pusat Pengajian Jejawi 3, Kawasan Perindustrian Jejawi, Universiti Malaysia Perlis (UniMAP), Arau 02600, Malaysia
[2]Centre of Excellent Geopolymer and Green Technology (CeGeoGTech), Universiti Malaysia Perlis (UniMAP), Kompleks Pusat Pengajian Jejawi 3, Kawasan Perindustrian Jejawi, 02600, Arau, Perlis, Malaysia
[3]Surface Technology Special Interest Group, Faculty of Chemical Engineering and Technology, Universiti Malaysia Perlis (UniMAP), 02600, Arau, Perlis, Malaysia

[*]juyana@utem.edu.my

Abstract. This paper explains the effect of a dimple micro-patterned substrate fabricated via photolithography on soldering applications. The dimple micro-pattern was fabricated on the copper substrate with a 100 – 500 µm diameter with a fixed depth of 23 ± 5 µm. The dimple micro-pattern substrate was metallurgically joined with Sn-0.7Cu lead-free solder alloy using the reflow soldering process. The dimple micro-pattern was examined using an optical microscope (OM) to observe all the critical parameters of the photolithography. The depth of the dimple(s) was observed and measured using a 3D surface profiler to obtain a micro-patterned depth of 23 ± 5 µm. The solder joints of the dimple micro-patterned substrate and the Sn-0.7Cu solder alloy were analysed in terms of their solderability, wettability, formation of intermetallic compounds (IMCs), and microstructures to determine the influence of dimple micro-patterning on the performance of the Sn-0.7Cu solder alloy. It was observed that a fixed depth of 23 ± 5 µm was achieved for all dimple diameters at an etching time of 45 minutes. In terms of the soldering performance of Sn-0.7Cu solder alloy on a micro-patterned substrate, it was observed that the diameters of the dimples, flow rate, and spreading area increased. At the same time, the IMC thickness decreased as the dimple's diameter increased. The dimple micro-pattern substrate enhances copper diffusion, which reduces the β-Sn area and promotes Cu-Sn intermetallic formation, resulting in a rich, fine eutectic area of solder compared to its non-patterned counterpart.

Keywords: Surface texture, dimple micro-pattern, photolithography, lead-free solder, Sn-0.7Cu, wettability.


EURO
INVENT

SECTION 3

MATERIALS APPLICATION

Investigation of Antioxidant Activity of Low Molecular Phenolic Compounds from Waste Hydrolyzed Lignocellulosic Material

Vilyana KAZANLAKLIEVA[1], Katrin CHAVDAROVA[1], Temenuzhka RADOYKOVA[1,*], Stela GEORGIEVA[1], Sanchi NENKOVA[2]

[1]Department of Analytical Chemistry, University of Chemical Technology and Metallurgy, 8 "St. Kl. Ohridski blvd, 1756 Sofia, Bulgaria
[2]Department of Pulp, Paper and Printing Arts, St. Kl. Ohridski blvd, 1756 Sofia, Bulgaria

[*]nusha_v@uctm.edu

Abstract. The possibility of obtaining valuable products with antioxidant properties from plant biomass was investigated. Low molecular phenolic compounds from the destruction of waste hydrolyzed lignocellulosic material were isolated by liquid-liquid extraction with various organic solvents and identified by GC-MS analysis. By spectral and voltammetric methods, the antioxidant activity of phenolic compounds was evaluated against the radicals: 2,2'-azino-bis(3-ethylbenzthiazoline-6-sulfone cation radical ($ABTS^+$) and 2,2-diphenyl-1-picrylhydrazyl (DPPH). As a reference antioxidant, Trolox, 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (a water-soluble derivative of vitamin E) was tested. In the search for solutions to improve the stability and durability of industrial polymer materials using compounds with antioxidant properties obtained from renewable resources, the antioxidant activity of toluene-extracted low molecular phenolic compounds, added in small amounts (1, 3 and 5%), on the thermo-oxidative stability of model polyurethane films in an air atmosphere was investigated.

Keywords: antioxidants, waste lignocellulosic material, phenol compounds.

Acknowledgments: Scientific Research Sector at the University of Chemical Technology and Metallurgy, Sofia, Bulgaria

Hydrogel Coatings and Regeneration: Bridging Science and Healing

Jeevithan ELANGO[1,*]

[1]Department of Biomaterials Engineering, Faculty of Health Sciences, UCAM Catholic University San Antonio de Murcia, Murcia-30107, Spain

[*]jelango@ucam.edu

Abstract. Hydrogels, with their remarkable properties, have emerged as a cornerstone in regenerative medicine. These three-dimensional networks of hydrophilic polymers exhibit exceptional biocompatibility, lubricity, and anti-biofouling characteristics, making them ideal candidates for a multitude of medical applications. It delves into the cutting-edge advancements and applications of hydrogel technology in tissue engineering, wound healing, and drug delivery systems. Due to their unique structural features, the hydrogels mimic the extracellular matrix and support cellular interactions. The biocompatibility and non-toxic nature of hydrogels allow for seamless integration with biological tissues, minimizing the risk of adverse reactions. The nature of hydrogel coatings enhances the performance of medical devices such as catheters and contact lenses. Also, the regenerative properties of hydrogels create a conducive environment for cell growth and differentiation, which makes them invaluable in tissue engineering. It has been demonstrated that the successful use of hydrogel scaffolds in regenerating skin, bone, cartilage, and muscle tissues. Additionally, the role of hydrogels in controlled drug delivery is showcasing their capacity to release therapeutic agents in a targeted and sustained manner, thereby promoting tissue regeneration and healing. Furthermore, the biodegradability of hydrogels is emphasizing their potential for gradual degradation and the release of bioactive molecules. This characteristic not only supports tissue integration but also reduces the need for additional surgical interventions. The work concludes by discussing future directions and potential advancements in hydrogel technology, highlighting the ongoing research and interdisciplinary collaborations aimed at enhancing their efficacy and expanding their applications. Through a comprehensive analysis of hydrogel coatings and their regenerative properties, this work aims to bridge the gap between scientific discovery and clinical practice, ultimately contributing to the advancement of regenerative medicine and improved patient care.

Keywords: hydrogels, coatings, tissue engineering, regenerative medicine.

Contributions to Improving the Quality of a Mechatronic ABS Braking System Optimized through Dynamic Performance

Daniel BALC[1], Aurel Mihail TITU[2,3,*], Marcin NABIAŁEK[4], Emanuel BALC[5]

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

[*]mihail.titu@ulbsibiu.ro

Abstract. The research focuses on optimizing the motor's dynamic performance by analyzing the impact of the variation in number of commutator bars. Through both theoretical modeling and experimental validation, the study investigates how changes in the commutator bar configuration influence key performance parameters such as torque stability, response time, efficiency, and thermal behavior. The motor design tries to rise to the existing models on the market and even surpass them by offering improved reliability and adaptability in high-stress braking scenarios. The experimented results indicated that by optimizing the number of commutator bars leads to significant improvements in braking system responsiveness and stability. This study will contribute to developing high-performance mechatronic ABS systems by reporting new insights into motor design strategies for automotive safety applications.

Keywords: DC motor, commutator bars, ABS braking system, dynamic performance, mechatronic optimization.

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Influence of Alloying Elements on the Stability and Performance of Cobalt Alloys for Medical Applications

Mihai TOFAN[1], Ioan Gabriel SANDU[1], Madalina Simona BALTATU[1], Andrei Victor SANDU[1,2], Petrica VIZUREANU[1,2,*]

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

[*] petrica.vizureanu@academic.tuiasi.ro

Abstract. Given their remarkable mechanical strength, biocompatibility, and resistance to wear, cobalt-based alloys are frequently utilized in medical applications. Alloying elements, which alter phase composition, corrosion resistance, and mechanical properties, have a major impact on the stability and performance of these alloys. As a primary stabilizer, chromium improves corrosion resistance and passivation by forming a protective oxide layer. Tungsten helps to strengthen solid solutions, while molybdenum increases strength and resistance to pitting. Although nickel increases toughness and encourages phase stability, its concentration needs to be managed to reduce any possible biocompatibility issues. By stabilizing the carbide and nitride phases and enhancing hardness and wear resistance, carbon and nitrogen improve microstructure. Controlled levels of iron improve manufacturing without sacrificing resistance to corrosion. The creation of cobalt alloys that are ideal for cardiovascular devices, dental prosthetics, and orthopedic implants is made possible by precise control over alloying elements, guaranteeing long-term functionality and biocompatibility in medical applications. The goal of ongoing research is to optimize cobalt alloys through surface modifications and advanced alloying techniques in order to improve mechanical performance, decrease metal ion release, and further improve biocompatibility. This will pave the way for the development of next-generation medical implants that will be safer and more stable over the long term.

Keywords: cobalt alloys, medical implants, alloying elements, phase stability, corrosion resistance, wear resistance, biocompatibility.

Biofunctionalization of Titanium-Molybdenum Alloys for Biomedical Applications

Andrei PRUTEANU[1], Madalina Simona BALTATU[1], Andrei Victor SANDU[1,2], Petrica VIZUREANU[1,2,*]

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

[*]petrica.vizureanu@academic.tuiasi.ro

Abstract. Titanium-molybdenum (Ti-Mo) alloys have emerged as promising biomedical materials due to their high mechanical properties, corrosion resistance, and biocompatibility. However, additional surface modifications are required to improve bioactivity and osseointegration, especially for orthopedic and dental implants. Several biofunctionalization techniques, such as anodization, chemical etching, plasma spraying, electrochemical deposition, and biomolecule immobilization, have been investigated to improve cell adhesion, proliferation, and antibacterial properties. Furthermore, coatings with bioactive ceramics (e.g., hydroxyapatite), polymeric layers (e.g., chitosan, polydopamine) are being developed to improve biological interactions and implant longevity. The incorporation of nanostructured surfaces, 3D-printed implant modifications, and smart coatings with controlled drug release are some of the upcoming trends in the biofunctionalization of Ti-Mo alloys. Furthermore, advances in biomimetic strategies, functional peptides, and antibacterial coatings have the potential to significantly improve implant success rates. The use of computational modeling and machine learning to design optimized surface treatments is gaining popularity, paving the way for personalized implant solutions. This study highlights recent advancements in Ti-Mo alloy biofunctionalization and explores future research directions aimed at developing next-generation biomedical implants with superior biocompatibility, osseointegration, and antibacterial performance.

Keywords: titanium-molybdenum alloys, biofunctionalization, surface modification, osseointegration, antibacterial coatings, hydroxyapatite.

Innovations in Construction Materials Production and Usage for Carbon Neutrality - Ecological Education

Ionela Luminita CANUTA (BUCUROIU)[1], Adrian IOANA[1,*], Augustin SEMENESCU[1], Diana Cristina LABES (CRACIUN)[1], Massimo POLLIFRONI[2]

[1] National University of Science and Technology POLITEHNICA Bucharest, Science and Engineering Materials Faculty, Spl. Independentei 313, Bucharest, Romania
[2] University of Turin, Italy

[*]adyioana@gmail.com

Abstract. In the production and use of building materials, carbon neutrality is leading to significant progress in this sector. In this paper, strategies and practices are designed to reduce the carbon footprint of building materials. Thus, the focus is on production processes, but also on the application of sustainable materials. The implementation of advanced recycling technologies, the development of low-carbon and negative-carbon materials, the integration of renewable energy sources are the key innovations. Case studies of successful projects highlight both the benefits and challenges encountered but demonstrate how these strategies can have real-world applicability. This paper, by properly examining current practices as well as future trends, provides a roadmap for the construction industry to achieve carbon neutrality. Thus, it contributes to broader efforts to mitigate climate change, but also to the promotion of a more sustainable built environment. Economic and technical aspects are addressed, considering the barriers to their widespread adoption, thus suggesting solutions to overcome these challenges.

Keywords: materials, innovations, carbon neutrality, environment, education.

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Accelerated Carbonation of Aggregates: A Sustainable Solution for Improving Mechanical Strength and Reducing the Carbon Footprint in the Construction Industry

Madalina Elena NICORICI[1], Călin G.R. MIRCEA[1], Oana CIASCAIU[1],Marta-Ioana MOLDOVEANU[1], Tudor Panfil TOADER[2,*]

[1]Technical University of Cluj-Napoca, IOSUD-UTCN Doctoral School, 15 Constantin Daicoviciu Street, Cluj-Napoca, Romania
[2]NIRD URBAN-INCERC Cluj-Napoca Branch, 117 Calea Floresti, Cluj-Napoca, , Romania

[*]toader.tudor@yahoo.com

Abstract. Accelerated carbonation of aggregates is viewed as a promising technological process studied througout the specialized literature, presenting a double benefit: the improvement of the physical and mechanical properties of aggregates used in the production of concrete and reducing enviromental impact by lowering the amount of CO_2 emitted into the atmosphere. This technology involves exposing aggregates to CO_2 in a controlled environment, wich facilitates the formation of calcium carbonate, reducing porosity and increasing their density. As a result of implementing this technology, according to the specialized literature, concrete elements with increased durability will be obtained, contributing to a greater utilization of recycled concrete. Furthermore, this method fits into the specifications of the circular economy by facilitating the capture and storage of CO_2 produced by various technological processes in the construction industry. This study proposes a synthesis of the specialized literature on the mechanisms of accelerated carbonation, the impact on the properties of aggregates used in concrete production, demonstrating its potential as a sustainable solution for reducing the carbon footprint and optimizing construction materials.

Keywords: recycled aggregates, accelerated carbonation, carbon footprint, circular economy, sustainable concrete.

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Floatable Syntactic Magnesium Foam as a Marangoni-Induced Propulsion Microboat

Gyorgy THALMAIER[1,*], Elisabeta CIURUS[1], Niculina A. SECHEL[1], Ioan VIDA-SIMITI[1,2]

[1] Faculty of Materials and Environmental Engineering, Technical University of Cluj-Napoca, 103 Muncii blv., Cluj-Napoca, Romania.
[2] Technical Science Academy of Romania, Dacia Ave., 26, Bucharest, Romania.

[*]gyorgy.thalmaier@sim.utcluj.ro

Abstract. Floatable syntactic foams were successfully manufactured from fine magnesium powder (<45 µm). Expanded perlite with a density of around 0.25 g/cm^3 and a size range between 0.2-0.4 mm was utilized as a pore former. Sample disks having a density as low as 0.73 g/cm^3 were manufactured by the classical press and sinter process. To maintain a high density the forming of the specimens was done at a pressure of 200 MPa in a hardened steel mold. Sintering was done in high vacuum (~3x 10^{-6} torr) at 620º C for 1h. The manufactured foams have sufficient strength to allow their machining into the shape of a microboat. Their possible application as a microboat using a Marangoni-induced propulsion [1, 2] were demonstrated as spontaneous locomotion was observed when etanol was used as a proppelant as a surface tension gradient arises between the upper and rear part of the microboat. Propulsion speeds of around 50 mm/s were achieved when using 100% purity etanol.

Keywords: magnesium, powder metallurgy, mechanical properties, syntactic foam.

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Technologies and Biomaterials for Manufacturing Surgical Guides Systems Used in Dental Implantology

Adriana ILEANA (BLAJAN)[1], Larisa POPESCU[1,*], Robert CIOCOIU[1], Alina ROBU[1], Iulian ANTONIAC[1]

[1]Department of Materials Science and Physical Metallurgy, Faculty of Material Science and Engineering, National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independentei Street, 060042, Bucharest, Romania.

[*]plarisa50@gmail.com

Abstract. The advancement of digital technologies has led to the extensive use of 3D printed surgical guide systems in dental implantology. These guides enable precise positioning of dental implants, enhancing both surgical accuracy and patient outcomes. This article explores the main 3D printing techniques used for fabricating dental surgical guides, including stereolithography (SLA), fused deposition modeling (FDM), and digital light processing (DLP). Each method offers distinct advantages in terms of resolution, printing speed, and material compatibility. A variety of biocompatible materials, such as photopolymer resins, thermoplastics, and composite blends, are used to ensure mechanical strength and clinical safety. The role of 3D printed guides is essential in transferring virtual implant planning into clinical reality with high precision. After fabrication, these guides are subjected to various characterization methods to assess their surface properties, scanning electron microscopy (SEM) for surface morphology, contact angle measurements for wettability, and surface roughness analysis for topographic evaluation. The integration of 3D printing into dental implant planning represents a significant advancement in personalized treatment, improving both predictability and efficiency in clinical practice.

Keywords: biomaterials, 3D printing, dentistry, microscopy, surface.

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A Perspective Review of Applications of the Computed Tomography in Industry and Research

Iuliana CORNESCHI[1,*], Elena PIEPTEA (POPESCU)[1], Aurora ANTONIAC[1], Alexandru STREZA[1], Gabriel CRISTESCU[1], Iulian ANTONIAC[1], Anca M. FRATILA[2]

[1]Department of Materials Science and Physical Metallurgy, Faculty of Material Science and Engineering, National University of Science and Technology POLITEHNICA Bucharest, 313 Splaiul Independentei Street, 060042, Bucharest, Romania.
[2]Lucian Blaga University of Sibiu, 10 Bulevardul Victoriei, 550024, Sibiu, Romania

[*]iuliacorneschi07@gmail.com

Abstract. Industrial X-ray computed tomography (CT) is a relatively new laboratory-based non-destructive testing technique used in a variety of industrial applications for samples ranging from 1 mm to usually 300 mm in diameter. CT has the advantage that the image data represent a local material-dependent property, the linear attenuation coefficient (μ), that is largely independent of object geometry. Typical industrial CT scan times are still 30–60 minutes or more depending on the quality required. The main use of the micro-CT scanners is the nondestructive testing for industrial product due to the superior resolution possible. Dimensional CT metrology is the only technology able to measure the inner as well as the outer geometry of a component without need to cut it through and destroy it. After a brief market overview, the paper gives a survey of state of the art and upcoming CT technologies, covering types of CT systems, scanning capabilities, and technological advances. The paper contains a survey of application examples from the manufacturing industry as well as from other industries, like electronic devices, medical devices, inhomogeneous and composite materials, and from the metallurgical factories. According to the scientific literature and our experimental measurements, the number of industrial applications of Computed Tomography (CT) is large and rapidly increasing.

Keywords: computed tomography, X-ray, resolution, nondestructive testing, industrial applications.

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Increasing the Efficiency of Electric Vehicle Transmission by Developing an Adaptive Gear Unit

Anton BASHIROV[1], Vitaliy SAVINKIN[1,*], Petrica VIZUREANU[2,3,*]

[1]Non-profit limited company "Manash Kozybayev North Kazakhstan University", Pushkin street, 86, Petropavlovsk, Kazakhstan
[2]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iaşi, Boulevard D. Mangeron, No. 51, 700050 Iasi, Romania
[3] Academy of Romanian Scientists, Bucharest, Romania

[*]cavinkin7@mail.ru, peviz2002@yahoo.com

Abstract. The research work is devoted to the study of the design of the electric vehicle transmission, and the development of a transmission aimed at increasing the energy efficiency and operational reliability of vehicles. The relevance of the topic is determined by the rapid development of the electric vehicle industry, the need to optimize the power drive and reduce energy losses during the transmission of power and torque from the electric motor to the drive wheels. The purpose of the study is to develop an electric vehicle transmission with simplified design and kinematic parameters that ensure efficient transmission of power and torque under various driving conditions. The work analyzes existing solutions, provides a comparative description of individual types of existing electric vehicle transmissions, torque transmission schemes, and substantiates the choice of the type of the designed transmission. Particular attention is paid to the calculation of the transmission efficiency parameters and their impact on the output parameters. As a result of the research, a transmission design with an adaptive gear unit has been developed, which has high rates of transmitted power and torque, with low energy costs. Calculations for strength and energy efficiency were carried out using CAD systems - KOMPAS-3D, MatLab Simulink. The practical originality of the work lies in the possibility of using the developed transmission in serial electric vehicles of the middle class. The results can be used in the design of new models of electric transport and in training courses on automotive engineering and mechatronics.

Keywords: electric vehicle, transmission, electric drive, gearbox, powertrain system, energy efficiency, power drive.

Rationale for Selecting the Process of Machining Parts Obtained with Additive Technologies

Alexander DROBYSHEV[1], Tatyana RATUSHNAYA[1,*]

[1]Non-profit limited company "Manash Kozybayev North Kazakhstan university", Pushkin street, 86, Petropavlovsk, Kazakhstan

[*]tratushnaia@mail.ru

Abstract. The aim of the study is to find the appropriate and optimal methods of subsequent machining of parts manufactured by additive manufacturing methods. The study identified the main problems of products made from metals and alloys by additive manufacturing methods, their potential for use in production and processing industries and surface indicators that can be obtained. The best ways of processing the various most common surfaces in mechanical engineering have also been selected, which can be used to assist with product design and construction and process planning, The best processing methods are defined to achieve the required characteristics based on additive production. Using the data obtained during the study can help in designing the design of machine parts and adapting already existing methods to introduce additive production technology into the manufacturing process, as a basis for creating a route map of processing or a quick estimate of the labour intensity of manufacturing the product, but the recommended chains of operations cannot be considered as reference because they are generalized and may not be effective in certain conditions. Also, the rapid development of technologies can lead to the loss of relevance of some machining methods. Further research in this field may provide data on the basis of which it will be possible to develop more suitable processing processes for parts, or to improve methods of additive manufacturing, allowing the production of surfaces, Suitable for the required requirements without further machining.

Keywords: additive technology, machining, 3D printing, metal processing, machining, "Hirtisation" technology.

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To Increase the Durability of the Rotary Impact Mechanism with a Submersible Pneumatic Hammer

Aigul KARAMGUZHINOVA[1], Vitaliy SAVINKIN[1,*], Andrei Victor SANDU[2,3,4,*]

[1]Non-profit limited company "Manash Kozybayev North Kazakhstan university", Pushkin street, 86, Petropavlovsk, Kazakhstan
[2]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iaşi, Boulevard D. Mangeron, No. 51, 700050 Iasi, Romania
[3]Romanian Inventors Forum, Str. P. Movila 3, 700089 Iasi, Romania
[4]Academy of Romanian Scientists, Bucharest, Romania

[*]cavinkin7@mail.ru, sav@tuiasi.ro

Abstract. During the extraction of minerals, strategically important metals of rare earth metals, drilling and explosive destruction of hard rocks is carried out. The energy efficiency of blast well drilling technology and the reliability of equipment is determined by the durability and reliability of the rock-crushing tool and its working body. It is established that the rational ratio of drilling speed and durability of the drilling tool, which determine the effectiveness of rotary impact drilling, is provided in a narrow range of its operating parameters. Efficiency also depends on torsional and longitudinal vibrations in the drilling rig – pneumatic hammer – chisel – face system, the level and nature of which vary over the depth range of the well. Studies have established that increasing the speed of drilling wells requires increasing the impact power of a submersible pneumatic hammer and providing a threshold value of impact energy for volumetric destruction of a rock mass with minimal energy consumption at the maximum possible impact frequency. The generally accepted way to solve this problem is to use high-pressure compressed air (up to 3.5 MPa). It is established that when designing a submersible impact mechanism, it is necessary to substantiate the material and its properties of the phase structure. To obtain high-strength structures (with a hardness of more than 52 HRC), quenching with low tempering should be used. If it is necessary to ensure high reliability of parts in high–strength condition (42-52 HRC), it is advisable to harden steel using heat treatment technology with mixed martensitic-bainitic transformation of austenite.

Keywords: submersible impact rotator, durability, working milling cutter, energy efficiency, Impact power.

Phosphate Coatings Based on Strontium Used in Biomedical Applications: A Short Review

Anca CAZAC[1], Diana-Petronela BURDUHOS-NERGIS[1], Andrei Victor SANDU[1], Petrica VIZUREANU[1], Costica BEJINARIU[1,2,*]

[1]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iasi, 67 Dimitrie Mangeron str., 700050 Iasi, Romania
[2]Academy of Romanian Scientists, Ilfov 3, 050044, Bucharest, Romania

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

Abstract. The paper aims to conduct a study on the research carried out in recent years on strontium phosphate conversion coatings used in biomedical applications. Strontium phosphate is commonly employed as a coating in the medical field, particularly for various types of implants in orthopedics and dentistry. Conversion coatings based on strontium phosphate (SrPO4) can provide significant corrosion resistance when used on magnesium and titanium alloys. Protective coatings are, therefore, a common option, given their high protective efficiency on Mg alloys. In particular, chemical conversion coatings are feasible and the approach is cost-effective, offering satisfactory corrosion resistance while benefiting from ease of operation and relatively low costs. Metal-phosphate conversion coatings outperform similar coating products due to their low-hazard environment, high cost-effectiveness, and outstanding performance protection. In order to obtain a phosphate layer with anticorrosive properties, a phosphating solution based on strontium phosphate must first be obtained, and then surface preparation and optimization of the phosphating parameters must take place. Since chemical conversion coatings with strontium phosphate on various substrates have rarely been investigated, this requires further research.

Keywords: strontium phosphate, biomaterials, chemical conversion coatings, phosphating, osseointegration.

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Statistical Study on the Sustainable Management of Construction Waste in the Republic of Moldova

Elena CIUTAC (NICOLAEV)[1], Daniela BURUIANA[1,*], Cătălina ITICESCU[2], Nicoleta BOGATU[1]

[1]Interdisciplinary Research Centre in the Field of Eco-Nano Technology and Advance Materials CC-ITI, Faculty of Engineering, "Dunarea de Jos" University of Galati, 47 Domneasca Street, 800008 Galati, Romania
[2]REXDAN Research Infrastructure, Department of Chemistry, Physics and Environment, "Dunarea de Jos" University of Galati, 47 Domneasca Street, 800008 Galati, Romania

[*]daniela.buruiana@ugal.ro

Abstract. The construction sector in the Republic of Moldova is currently in an incipient phase regarding the implementation of sustainable construction waste management strategies. This paper provides a comprehensive analysis of the current situation, focusing on the typology, volume, and distribution of construction waste, with statistical evidence highlighting wood, brick, and concrete as predominant categories. Emphasis is placed on the applicability of circular economy principles, particularly the reuse and recycling of materials, as a means to mitigate environmental degradation and promote resource efficiency. In conclusion, the study emphasizes the critical need for an integrated and systematic approach to construction waste management, which is essential for aligning the sector with the broader goals of sustainable development.

Keywords: sustainable development, construction waste, Republic of Moldova, statistical analysis, recycling.

Virtual Assistant for Fire Protection

Catalin OPRITA[1,*], Constantin Stelian STAN[1], Iuliana STAN[1], Beatrice TORAC TOMA[1], Alexandra OPRITA[1]

[1]Competence Centre: Faculty of Materials Science and Engineering, University of Science and Technology POLITEHNICA Bucharest, Romania

[*]catalin.oprita@stud.sim.upb.ro

Abstract. Metal panels made from various types of steel ensure protection and safety against thermal radiation in situations where people and goods may be exposed to this risk during a fire. Analyzing the evolution of thermal flow when metal panels of different thicknesses are subjected to thermal radiation can yield insights into the optimal characteristics of steel sheets and their effectiveness in protecting against fire. The role of artificial intelligence (AI) in analyzing heat flow evolution through simulations of steel sheets exposed to fire, with varying dimensions and technical characteristics, including different chemical compositions, ultimately results in the centralization of findings and the creation of a database detailing the parameters and characteristics of these sheets for use as fire protection metallic panels.

Keywords: AI, thermal radiation, safety, metal materials, protection, fire, safety, protection.

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A Virtual Assistant to Evaluate Pollution Levels in the Heat Treatment Sector

Beatrice TORAC TOMA[1,*], Constantin Stelian STAN[1], Iuliana STAN[1], Catalin OPRITA[1], Alexandra OPRITA[1]

[1]Competence Centre: Faculty of Materials Science and Engineering, University of Science and Technology POLITEHNICA Bucharest, Romania

[*]beatrice.oprita@stud.sim.upb.ro

Abstract. The principle of H&S risk assessment, from the point of view of occupational exposure, in an industrial sector of heat treatments, is based on simplified techniques for creating models adapted to the type of activity carried out and calculation methods with weighted values. The implementation of neural software, related to artificial intelligence (AI), to carry out complex analyses, regarding the occupational exposure of workers, can facilitate the obtaining of a wide range of data and estimates, or work models, which help to obtain a final wellbeing, at the workplace. Neural network operating methods can be used by "forward" propagation, in which input data is transmitted through the network, layer by layer, applying activation functions to each neuron, to produce an "output", as a final result. In our case, automatic learning of AI involves building a model based on a training set, training the AI using recordings obtained based on experimental data.

Keywords: AI, heat treatment, metal, safety, protection, wellbeing.

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A Study on the Fabrication of a Smart Water Quality Sensor for Semiconductor Cluster Ultra-Pure Water Facilities

Juhyeong KIL[1]

[1]Lotus Prosuming Management, 3F, 3 Hangeulbiseok-ro 46na-gil, Nowon-gu, Seoul, Korea

[*]kjh@lotuselectrode.com

Abstract. Semiconductor manufacturing is a high-precision industry that demands an ultra-clean environment, where the stable and high-quality supply of ultra-pure water (UPW) plays a pivotal role. Within semiconductor clusters, even minor fluctuations in UPW quality can significantly impact product yield and process reliability. As such, real-time and high-precision control of key water quality parameters including electrical conductivity (EC) is essential. EC serves as a critical indicator of ionic concentration in water and is highly sensitive to temperature. It also exhibits strong correlations with total dissolved solids (TDS) and degas equilibrium quality (DEQ), both of which are important for evaluating the purity and degassing efficiency of UPW. This study presents the design and development of a smart EC-based water quality sensor module, specifically optimized for UPW systems in semiconductor manufacturing facilities. The proposed sensor integrates a high-precision EC measurement cell and a temperature sensor into a compact unit, supported by an embedded microcontroller-based algorithm. This architecture enables real-time output of temperature-compensated EC values, as well as calculated TDS and DEQ metrics, all within a single sensing platform. The performance of the developed sensor was evaluated under various operating conditions, demonstrating superior accuracy, repeatability, response time, and long-term stability when compared to conventional commercial sensors. Additionally, the compact, all-in-one design offers practical advantages in terms of space efficiency and maintenance simplicity. This research provides a practical implementation of a high-reliability, high-sensitivity water quality monitoring solution, and establishes a technical foundation for smart water management infrastructure in next-generation semiconductor fabrication environments.

Keywords: electrical conductivity sensor, ultra-pure water, UPW, semiconductor cluster, total dissolved solids, TDS, degas equilibrium quality, DEQ, temperature compensation.

Innovations in One-Dimensional Consolidation Testing: A Review of the Double-Action Oedometer

Zakaria OWUSU-YEBOAH[1,*], Mircea ANICULAESI[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.

[*]zakaria.owusu-yeboah@student.tuiasi.ro

Abstract. This study presents an in-depth evaluation of the double-action oedometer (DAO) as an advanced testing apparatus for simulating soil compressibility under near-field conditions. Unlike the classic oedometer, which enforces full lateral confinement and single-direction loading, the DAO introduces a dual-loading mechanism. A large platen simulates preconsolidation pressure (σ_p'), while a concentric piston does the incremental vertical loads which in effect allows partial lateral deformation. The objective is to reflect the in-situ anisotropic stress paths so that post-test theoretical corrections could be minimised. Silty clay samples were tested using both the DAO and the classic oedometer. Compressibility parameters E_{oed}, C_c, m_v and a_v were compared. The DAO results recorded higher stiffness ($E_{oed} = 10{,}867\ kPa$), reduced strain and more realistic e_i trends. The DAO E_{oed} in comparison with the classic give $M_0 = 1.04$ which is lower than the theoretical M_0 from the correction coefficeint in the NP 112/2014. These outcomes could indicate the overestimation of the M_0 in theoretical standards. Additionally, the lower strain and settlement yields from the DAO testing under identical stress levels indicate reduced influence of sample disturbance. This leads to improved prediction of settlement and more accurate derivation of compressibility parameters used in design. The DAO demonstrates clear benefits for geotechnical modelling, offering a cost-effective alternative to classic and modified oedometers. Its potential for standardization and integration into geotechnical codes is significant.

Keywords: double-action oedometer, soil compressibility, preconsolidation pressure, lateral deformation, oedometer modulus.

Investigation of the Influence of Natural Fillers on the Properties of Samples Obtained by Additive Manufacturing Technology

Marta KRAWCZYK[1,*], Rafał PRZYBYLSKI[1], Paweł FIGIEL[1], Konrad KWIATKOWSKI[1]

[1]Faculty of Mechanical Engineering and Mechatronics, West Pomeranian University of Technology in Szczecin, 19 Piastów Av., 70-310 Szczecin, Poland

[*]mkrawczyk@zut.edu.pl

Abstract. Natural materials are attracting the interest of researchers as reinforcement in polymer composites due to their low cost, lightweight, good mechanical properties, and biodegradability. Polymeric composite materials are usually produced by classical methods, but with the development of manufacturing techniques, they have also become the focus of research in the area of additive manufacturing. This study examined the impact of natural fillers on the properties of polymeric materials applied in additive manufacturing. Commercially available PLA (polylactic acid) matrix materials with 40% wood, bamboo, and cork in fiber and powder form were used. The results obtained were related to the pure material. The specimens were obtained by additive manufacturing using Material Extrusion (MEX) technology with constant process parameters for each material. Thermal decomposition, density, absorption, shrinkage, tensile strength, and impact strength of the obtained samples were analyzed. It was observed that the natural fillers used in the study lowered the density and tensile strength while improving the impact strength. No significant effect on thermal stability was noted.

Keywords: MEX, polymer composites, natural filler, additive manufacturing.

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Plasma Exposure as Green Method to Enhance Surface Adhesion of Commercial Polymers for 3D Printing

Bianca Dumitrita TATARCAN[1],
Florentina Daniela COJOCARU[1], Marius DOBROMIR[2],
Andrei Vasile NASTUTA[1,*]

[1]Physics and Biophysics Education Research Laboratory, Biomedical Science Department, Faculty of Medical Bioengineering, 'Grigore T. Popa' University of Medicine and Pharmacy Iasi, Iasi, Romania
[2]Department of Exact and Natural Sciences, Institute of Interdisciplinary Research, Alexandru Ioan Cuza University of Iasi, Iasi, Romania

[*]nastuta.andrei@umfiasi.ro

Abstract. When it comes to biomedical applications, it is very critical to study surface modifications of polymers in order to improve adhesion, chemical characteristics, wetting behavior, and interactions with biological fluids and the human body. A 10 W high-voltage power source was used to start a jet-type dielectric barrier discharge in argon and helium. The applied voltage and discharged current were monitored using fundamental electrical diagnostic techniques. By means of optical emission spectroscopy, species that were excited by plasma were investigated [1-3]. Three polymers frequently used in 3D printing (PLA, ABS, PETG) were the subject of this plasma treatment investigation. This study set out to determine how well plasma sources work for promoting surface changes for better adhesion between polymeric layers. Surface morphology and chemical behaviour measurements were used in studies of surface changes after plasma exposure. This study's plasma source successfully alters polymeric materials to enhance surface adhesion.

Keywords: plasmas-polymer interaction; polymer surface characterization.

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Assessment of the Influence of Ammonium Loading from Wastewater on the Photosynthetic Activity of Microalgae

Tatiana BUSE[1,2,*], Olga TIRON[1]

[1]National Research and Development Institute for Industrial Ecology - ECOIND, 57-74 Drumul Podu Dambovitei, Bucharest, Romania
[2]Faculty of Biotechnical Systems Engineering, National University of Science and Technology Politehnica Bucharest, 313 Splaiul Independenței, Bucharest, Romania

[*]tatiana.buse@ecoind.ro

Abstract. The increasing degree of urbanization places growing pressure on the quality of wastewater, which is characterized by high concentrations of nitrogen compounds - especially ammonium. Although ammonium is vital for microorganism growth, at elevated concentrations it becomes toxic, disrupting the taxonomic balance and reducing the efficiency of biological treatment processes. In the context of the circular economy and the need to minimize the use of chemical resources in wastewater treatment plants, microalgae have been extensively studied for their ability to use pollutants as a source of nutrients, thus contributing to its removal from the environment. Despite their high biotechnological potential, the impact of variable ammonium concentrations on different microalgae species is not yet fully covered, especially under conditions of pronounced nutritional stress. This study aimed to evaluate the effects of varying ammonium concentrations on microalgae culture, emphasizing the need to understand their tolerance thresholds required to harness them effectively in sustainable biotechnologies. Experiments conducted on the *Chlorella* sp. strain yielded interesting data showing a high adaptation to ammonium-induced stress. Understanding the consequences of ammonium load fluctuations in wastewater is an important step toward developing sustainable solutions and contributes to the advancement of bio-based treatment strategies in wastewater treatment plants.

Keywords: microalgae, ammonium, wastewater treatment, photosynthesis.

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A Mini Review on Antibiotic Resistance Genes in the Environment

Monica MATEI[1], György DEÁK[1, 2], Raluca PRANGATE[1, 2,*], Mădălina BOBOC[1], Laura LUPU[1], Cristina CROITORU[1], Dana MIERLA[1], Melania PENCEA[1], Tatiana BUSE[1,2,*], Olga TIRON[1]

[1]National Institute for Research and Development in Environmental Protection, Splaiul Independenţei 294, Bucharest, Romania
[2] Doctoral School of Biotechnical Systems Engineering, National University of Science and Technology POLITEHNICA of Bucharest, Splaiul Independenței 313, Bucharest, Romania

[*]raluca.prangate@incdpm.org, tatiana.buse@ecoind.ro

Abstract. Antibiotic resistance, also referred to as a 'silent pandemic', has emerged as a major global health concern in recent years. Excessive and unregulated use of antibiotics for the treatment of pathogenic microbial diseases, together with inadequate waste treatment containing unmetabolised drugs and their residues, leads to increased concentrations of antibiotics in the environment, resulting in 'antibiotic pollution'. Once in the environment, bacteria are able to acquire new resistance factors from other species, reducing our ability to prevent and treat bacterial infections. This phenomenon, is a major contributor to antibiotic resistance, which in turn has serious global consequences and contributes to increased human morbidity. The objective of this brief review is to examine and analyse the distribution of antibiotic resistance genes in the environment, the underlying factors that lead to antimicrobial resistance, and the potential solutions to this issue.

Keywords: antimicrobial resistance, global health, environment.

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Multi-walled Carbon Nanotubes on Plastic for Nitrogen Dioxide Flexible Gas Sensor

Muhammad Mahyiddin RAMLI[1,2,*], Nurul Huda OSMAN[3], Shazlina JOHARI[1], Norizah ABD KARIM[2], Ismariza ISMAIL[2], DARMINTO[4], Ali H. RESHAK[5,6]

[1]Faculty of Electronic Engineering Technology, Universiti Malaysia Perlis, 02600 Arau, Perlis, Malaysia
[2]Institute of Nanoelectronic Engineering, University Malaysia Perlis, Perlis, Malaysia
[3]Applied Electromagnetic Laboratory 1, Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[4]Department of Physics, Faculty of Mathematics and Sciences, Sepuluh November Institute of Technology, Surabaya 60111, Indonesia
[5]Physics Department, College of Science, University of Basrah, Basrah, Iraq
[6]Department of Instrumentation and Control Engineering, Faculty of Mechanical Engineering, Czech Technical University in Prague, Technicka 4, Prague 6 166 07, Czech Republic

[*]mmahyiddin@unimap.edu.my

Abstract. Carbon based sensors aroused the interest among researchers due to their lower operating temperature, higher performance and sensitivity at lower cost production. The flexibility of this material to be manipulated makes these nanotubes are favored to be used in wearable sensor. This sensor can be applied in various applications including gas sensor. Based on the report, nitrogen dioxide (NO2) has been listed among the hazardous gas that can give short and long term effects especially to the groups that highly exposed like farmers and armies. In this paper, Multi-walled carbon nanotubes (MWCNTs) was fully utilized as the sensing material for NO2 gas sensor. The MWCNTs was acid functionalized to improve its solubility. The nanotubes film on the flexible polycarbonate membrane was obtained using vacuum filtration method. In order to complete the sensor, gold electrode was deposited on top of the film before exposed to the NO2 in a simple setup. First, the device was exposed at three different gas concentrations; 8.68, 17.3, 412 ppm. The results show that the resistance of the sensor was decreased as the concentration of the gas increased. Then, the sensor also tested at three different temperatures and it shows that this sensor can be operated at room temperature with sensitivity of 15%. Better sensitivity (~20%) and response time was recorded as the temperature increased at 200 °C.

Keywords: carbon nanotubes, wearable sensor, gas sensor, electronic materials.

Graphene for Dye Sensitized Solar Cell Counter Electrode: A Review

Muhammad Mahyiddin RAMLI[1,2,*], Nurul Huda OSMAN[3], Shazlina JOHARI[1], Norizah ABD KARIM[2], Ismariza ISMAIL[2], DARMINTO[4], Ali H. RESHAK[5,6]

[1]Faculty of Electronic Engineering Technology, Universiti Malaysia Perlis, 02600 Arau, Perlis, Malaysia
[2]Institute of Nanoelectronic Engineering, University Malaysia Perlis, Malaysia
[3]Applied Electromagnetic Laboratory 1, Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[4]Department of Physics, Faculty of Mathematics and Sciences, Sepuluh November Institute of Technology, Surabaya 60111, Indonesia
[5]Physics Department, College of Science, University of Basrah, Basrah, Iraq
[6]Department of Instrumentation and Control Engineering, Faculty of Mechanical Engineering, Czech Technical University in Prague, Technicka 4, Prague 6 166 07, Czech Republic

[*]mmahyiddin@unimap.edu.my

Abstract. The demands on dye sensitized solar cell were increased as it appears as the best alternative to the reliable, efficient, green technology and low cost production photovoltaic device. Along the way, the wondrous material graphene has become the most potential material that can be used as the counter electrode to enhance the photocatalytic activity. This review focuses on the recent development and performance of the solar cells that applied graphene, reduced graphene oxide and hybrid graphene-carbon nanotubes as the main material for the counter electrode in dye sensitized solar cell.

Keywords: graphene, counter electrode, dye sensitized solar cell, photovoltaic.

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Coal Ash as a Sustainable Cement Replacement in Concrete: A Recycling Approach

Afikah RAHIM[1,*], Nursyazana Nabilah MOHAMAD ANUAR[1], Nordiana MASHROS[1], Muhammad Farhan ZOLKEPLI[1], Nor Zurairahetty MOHD YUNUS[1], Khairul Azlan MUSTAPHA[2], Thian Lai GOH[3], Nurul Masyiah Rani HARUSI[4], Badrul A. ALAM[5], Hamzah HUSSIN[6], Junhui MOU[7]

[1]Department of Geotechnical and Transportation Engineering, Faculty of Civil Engineering, Universiti Teknologi Malaysia,81310 Johor Bahru, Malaysia
[2]Department of Geology, Universiti Malaya, 50603 Kuala Lumpur, Malaysia
[3]Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Selangor, Malaysia
[4]Departemen Teknik Lingkungan, Fakultas Teknik, Kota Makassar, Sulawesi Selatan, Indonesia
[5]Department of Petroleum & Mining, Faculty of Civil Engineering, Military Institute of Science and Technology, Dhaka, 1216 Bangladesh
[6]Department of Geoscience, Faculty of Earth Science, Universiti Malaysia Kelantan, 17600, Jeli, Kelantan, Malaysia
[7]National Engineering Research Center for Coal & Gas Control, China University of Mining & Technology, Xuzhou 221008, PR China.

[*]afikahrahim@utm.my

Abstract. This paper presents the analysis of coal in one of the coal fields in Malaysia which is Mukah- Balingian in Sarawak. The paper is to study the characterization of coal by identify the geochemical content and quality of coal. The coal from the site also had been taken for testing in lab such as proximate analysis and ultimate analysis. The result from proximate analysis will show the moisture content, volatile matter, ash and fixed carbon. From this result, percentage of volatile matter and fixed carbon will determine the type and rank of the coal. For ultimate analysis, CHNS analysis had been used to determine the contents of Carbon(C), Hydrogen (H), Nitrogen (N) and Sulphur (S). Mortar mixtures were prepared using different proportions of ash as partial replacement of cement. Mortars of 50x50x50mm (width, height, length) and curing times of 3, 7 and 28 days were evaluated for workability and compressive strength. There was improvement in the compressive strength of mortar with 30% ash substitution in comparison with control mixtures. This study proved that the uses of ash up to 30% can be used as replacement of cement to obtain good strength of mortar.

Keywords:coal, geochemical content, CHNS analysis, mortar cement, cement replacement.

Solvent-Free Spherification of Bovine Serum Albumin in Recycled Oil Phase without Surfactants

Yu CHANG[1,*]

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

[*]eddie@wiipa.org.tw

Abstract. This study presents a novel method for the spherification of bovine serum albumin (BSA) under solvent-free conditions, utilizing a recycled oil phase without the addition of surfactants. By eliminating organic solvents and surfactants, the process significantly reduces environmental impact and potential toxicity, while maintaining high encapsulation efficiency and structural integrity of the protein spheres. The oil phase was reused in multiple cycles without compromising the quality of the microspheres, demonstrating the sustainability and practicality of the method. This technique provides a promising platform for green encapsulation strategies in biomedical and pharmaceutical applications.

Keywords: Bovine serum albumin, spherification, solvent-free, surfactant-free, recycled oil phase, green chemistry, protein encapsulation, microspheres.

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Eco-Dying on ZnO Nanoparticles Using Tamarindus Indica L. Seed Coat Tannin

Shaniba PALAMADATHIL[1], Abdul Kareem THOTTOLI[2], Sreelakshmi PUTHUMANA MELEPATTU[2], Shivina NANDHAYIL PARAMBIL[3], Athira PRAKASH[4], Muhasin Mubarak KODAPEEDIYEKKAL[5], Labeeba M.[6], Islam M. Al-AKRAA[7], Ahmad M. MOHAMMAD[7], Ayu Wazira AZHARI[8,*], Dewi Suriyani CHE HALIN[9,10]

[1]Govt.College Malappuram Munduparamba, Malappuram, Kerala, India
[2]Department of Physics, PSMO College, Tirurangadi, Malappuram, Kerala, India
[3]Grace Valley College of Arts and Science, Maravattam, Malappuram, Kerala, India
[4]Kottakkal Farook Arts and Science College, Kottakkal, Malappuram, Kerala, India
[5]Jamia Nadwiyya Arts and Science College, Edavanna, Malappuram, Kerala, India
[6]Department of Chemical Engineering, Faculty of Engineering, The British University in Egypt, Cairo 11837, Egypt
[7]Chemistry Department, Faculty of Science, Cairo University, Cairo 12613, Egypt
[8]Environmental Engineering Department, Faculty of Civil Engineering and Technology, Universiti Malaysia Perlis, 02600, Perlis, Malaysia
[9]Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[10]Centre of Excellent Geopolymer & Green Technology (CeGeoGTech), Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia

[*]ayuwazira@unimap.edu.my

Abstract. Tamarindus indica L. seed coat tannin was extracted and analysed for its optical absorption and FTIR spectra. The extracted tannin was utilised as a natural dye to sensitise ZnO nanoparticles, enhancing their optical absorption properties into the visible region. ZnO nanoparticles were synthesised in the presence of varying concentrations of Tamarindus indica L. seed coat tannin to investigate its impact on their growth and optical behaviour. Results demonstrated that the prepared nanoparticles retained a particle size of approximately 17 nm, as confirmed by the XRD and TEM analysis. In addition, the tamarind seed coat tannin, which is rich in polyphenolic compounds, significantly improved the optical performance of the eco-dyed ZnO nanoparticles, shifting the absorption spectrum into the visible region from 400 nm to 800 nm. This work highlights the potential of tamarind seed coat tannins as sustainable, functional nanomaterials in dye-sensitised solar cells and other optoelectronic devices.

Keywords: eco-dyeing, Tamarindus Indica L., ZnO nanoparticles, dye-sensitised ZnO.

Synthesis of TiO_2/ZnO Thin Film as an Electron Transfer Layer for a Perovskite Solar Cell

Dewi Suriyani CHE HALIN[1,2,*], Mohd Arif Anuar MOHD SALLEH[1,2], Ayu Wazira AZHARI[3], Rita MOHD SAID[1,2], Nur Izzati MUHAMMAD NADZRI[1,2], Juyana A WAHAB[1,2], Alida ABDULLAH[2,4], Mohd Sharizal ABDUL AZIZ[5], Andrei Victor SANDU[6,7,8], Noraiham MOHAMAD[9]

[1]Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[2]Centre of Excellent Geopolymer & Green Technology (CeGeoGTech), Universiti Malaysia Perlis (UniMAP), 02600 Arau, Perlis, Malaysia
[3]Faculty of Civil Engineering & Technology, Universiti Malaysia Perlis, Perlis, Malaysia
[4]Faculty of Mechanical Engineering & Technology, Kampus Tetap Pauh Putra, Universiti Malaysia Perlis, 02600 Arau, Perlis, Malaysia
[5]School of Mechanical Engineering, Engineering Campus, Universiti Sains Malaysia, 14300 Nibong Tebal, Seberang Perai Selatan, Penang, Malaysia
[6]Faculty of Materials Science and Engineering, Gheorghe Asachi Technical University of Iaşi, Boulevard D. Mangeron, No. 51, 700050 Iasi, Romania
[7]Romanian Inventors Forum, Str. P. Movila 3, 700089 Iasi, Romania
[8]National Institute for Research and Development for Environmental Protection INCDPM, 294 Splaiul Independentei, 060031 Bucharest, Romania
[9]Fakulti Kejuruteraan Pembuatan, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka, Malaysia

[*]dewisuriyani@unimap.edu.my

Abstract. Titanium dioxide (TiO_2) has been widely used as an electron transfer layer in perovskite solar cells (PSCs) due to the high efficiency and low-cost fabrication. Nevertheless, TiO_2 suffers from low electron mobility and high defect-state density which limits the overall device performance. Nowadays, researchers are exploring new materials and fabrication techniques to enhance the performance of PSCs under various environmental conditions. ZnO has been found as an attractive material with their unique electron pathways, a promising candidate owing to its transparency, suitable energy band structure and high electron mobility. In this work, TiO_2 was doping with 2 wt% and 4 wt% of ZnO using a sol-gel method and the obtained thin films were annealed at 300 °C – 500 °C. The XRD pattern shows when the amount of 4 wt% of ZnO was added and annealed at 500 °C, the peak revealed was TiO_2 anatase phase. From the microstructure, it clearly seen the increasing of wt% of ZnO and the annealing temperature, the size of porous structure becomes larger. The absorption increased when 4 wt% of ZnO was added into the TiO_2 solution. The value of band gap TiO_2/ZnO decreased to 3.1 eV due to a large surface area and a stronger absorption which was attributed to its mesoporous structure as demonstrated in SEM image.

Keywords: TiO_2, ZnO, thin film, sol-gel, perovskite solar cells

Nanostructured Materials for Enhanced Performance of Sensory Systems in Food Industry

Andrei IVANOV[1], Daniela BURUIANA[1,*], Constantin TRUS[1], Iulian Vasile ANTONIAC[2,3]

[1]Department of Materials and Environmental Engineering, Faculty of Engineering, "Dunarea de Jos" University of Galati, Strada Domneasca 47, 800008 Galati, Romania
[2]Faculty of Material Science and Engineering, National University of Science and Technology Politehnica Bucharest, 313 Splaiul Independentei, District 6, RO-060042 Bucharest, Romania
[3]Academy of Romanian Scientists, 54 Splaiul Independentei, RO-050094 Bucharest, Romania

[*]daniela.buruiana@ugal.ro

Abstract. In this research work, the core focus was given to nanoparticle synthesis and characterization, carbon nanostructure synthesis, and biodegradable nanomaterial synthesis enhancing sensitivity, selectivity, and the real-time monitoring function of active and intelligent food packaging systems. Novel environmentally friendly methods are used for synthesizing nanomaterials including metal nanoparticles, carbon nanotubes, graphene derivatives, and cellulose nanofibers. Their incorporation into sensor platforms was determined by physicochemical and functional characterizations that allowed them to sense spoilage indicators such as gases, volatile organic compounds, pH fluctuations, and microbial metabolites with significant improvements in sensitivity. The observed results indicate the enhancement in performance of such nanostructured materials that allow rapid, accurate, and inexpensive food quality measurements and determination of shelf-life. These enhancements are not only advantageous in terms of food safety and prevention of food wastage but also for worldwide sustainable development.

Keywords: nanostructured materials, sensors, food quality, active packaging, intelligent packaging, food spoilage detection.

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SECTION 4

MATERIALS & LIFE SCIENCE

Repurposing the Monuments of Industrial Architecture into Modern Public Spaces of Art Direction

Oleksandr IVASHKO[1,*], Andrii DMYTRENKO[2], Tomasz KOZŁOWSKI[3]

[1]Kyiv National University of Construction and Architecture, 31 Povitrianykh Syl Avenue, Kyiv, 03037, Ukraine
[2]National University "Yuri Kondratyuk Poltava Polytechnic", 24 Vitaliia Hrytsaienka Avenue, 36011, Poltava, Ukraine
[3]Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31–155 Cracow, Poland

[*]ghok2233@gmail.com

Abstract. The article is devoted to the problems of repurposing historical industrial facilities for new functions. The main issues of such measures and the necessary conditions for their feasibility are identified. The existing experience of preserving industrial facilities with a change of function is analyzed and how it can be used in the post-war reconstruction of Ukraine. The main requirements are the location in the centre of large cities with good transport accessibility and residential areas nearby. Examples are given of how new centres of public attraction with an artistic function arise on the site of industrial sites with the preservation of historical industrial buildings.

Keywords: repurposing, industrial architecture monument, modern public space, artistic direction.

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Grape Pomace: A Circular Economy Approach to Valorizing a Sustainable By-Product

Georgiana-Diana GABUR[1], Valeriu V. COTEA[1], Iulian GABUR[1,*], Carmen TEODOSIU[2]

[1]Department of Horticultural Technologies, Faculty of Horticulture, "Ion Ionescu de la Brad" Iasi University of Life Sciences, 3 Mihail Sadoveanu Str, Iasi, Romania
[2]Department of Environmental Engineering and Management, "Gheorghe Asachi" Technical University of Iasi, 73 Prof. Dimitrie Mangeron Street, 700050 Iasi, Romania

[*]iulian.gabur@iuls.ro

Abstract. Grapes are one of the world's most popular fruits, often processed into various food products and beverages. A large proportion of grape production is devoted solely to winemaking, a complex chemical process that generates significant by-products usefull in circular economy. Among these by-products, grape pomace or grape marc is considered to be the most valuable, as it consists of skins, seeds and stalks remaining after the pressing of grape. The aim of this review is to examine recent advances in the valorisation of grape pomace and to explore its potential as a valuable material with multiple applications in different industries. This review discusses the main methods of valorization of grape pomace, including traditional approaches such as the production of distillates, animal feed and soil fertiliser. Moreover, it covers the grape pomace role as a technological aid in various industrial processes such as adsorption, immobilisation, food packaging, cosmetics, food products and as a raw material for bioenergy production.

Keywords: grape pomace, circular economy, by-product, valorization.

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Sustainable Utilization of Agricultural Residues from Fruit Shrubs: Energy Potential and Physical-Chemical Properties

Grigore MARIAN[1], Alexandru BANARI[1,*], Teodor MARIAN[2]

[1]Technical University of Moldova, 168 Ștefan cel Mare Blvd., Chisinau, Republic of Moldova
[2]CC „BASADORO AGROTEH" LLC, Republic of Moldova, PhD student TUM

[*]alexandru.banari@sfc.utm.md

Abstract. The energy crisis, population growth, and rising living standards exert significant pressure on energy resources and the environment in the Republic of Moldova. In this context, the utilization of agricultural residues, which are abundantly available in rural areas, for renewable energy production from biomass gains increasing importance. This study aims to evaluate the sustainable potential of residues generated by fruit-bearing shrubs, a crop that is expanding in the Republic of Moldova. The physical and chemical properties of biomass derived from the most widespread fruit shrub species cultivated in the country—raspberry, blackberry, gooseberry, currant, blueberry, and sea buckthorn—were analyzed. For these species, the sustainable energy potential and the prospects of using biomass as a raw material for producing densified solid biofuels have been determined. Proximate and ultimate analyses of biomass samples were conducted using standardized and validated methods at the Scientific Laboratory of Solid Biofuels of the Technical University of Moldova. The obtained data indicate that the highest sustainable energy potential is recorded for blackberry biomass (54.78±4.48 GJ/ha), followed by sea buckthorn (42.20±1.37 GJ/ha) and raspberry (40.59±3.79 GJ/ha). The lowest values were recorded for gooseberry and currant biomass, influenced by both lower biomass yields per hectare and lower calorific values.

Keywords: biomass, fruit-bearing shrubs, sustainable energy potential, calorific value.

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In Vitro Evaluation of Antimicrobial Activity and Fibroblast Biocompatibility of Hydrogels Loaded with Cyclodextrin Inclusion Complexes of Non-Psychoactive Cannabinoids for Wound Healing Applications

Dulexy SOLANO-ORRALA[1,2],
Sandra HERRANZ-GÓMEZ[2], Daniel PEÑA-JIMENEZ[2],
Camilo ZAMORA-LEDEZMA[1,2,*]

[1]Escuela de Ingeniería, Arquitectura y Diseño, Universidad Alfonso X el Sabio (UAX).
Avenida de la Universidad 1, 28691 Villanueva de la Cañada, Madrid, Spain
[2]Biomedical Research Unit (UIB-UAX), Universidad Alfonso X el Sabio (UAX).
Avenida de la Universidad 1, 28691 Villanueva de la Cañada, Madrid, Spain

[*]camilza@uax.es

Abstract. Hydrogels containing nonpsychoactive cannabinoids (NPCs) show promise as biomaterials for wound treatment [1-3]. However, the controlled release of these NPCs using cyclodextrins (CDs) for molecular encapsulation has not yet been explored. In this study, we analyze the antimicrobial and cell proliferative properties of agar/xanthan gum hydrogels that are loaded with cyclodextrin complexes and non-psychoactive cannabinoids, including Cannabidiol (CBD) and Cannabinol (CBN). Four samples were analyzed: 1) Hydrogel without CD, 2) Hydrogel with CD, 3) Hydrogel with CD/CBD, and 4) Hydrogel with CD/CBN. The findings from the antimicrobial assay targeting E. coli and S. aureus showed that Hydrogel CD/CBD exhibited greater inhibition activity against S. aureus, as demonstrated by the agar diffusion test. The dynamics of bacterial attachment and growth were examined through 24-hour optical density experiments, with absorbance recorded hourly. MTT and AlamarBLue assays were performed at 1, 3, and 7 days using CRL-2648 Fibroblast cell line. The (H-CNP/CDs) hydrogel shows potential as a scaffold for tissue regeneration, indicated by the lack of citoxicity and viable cell percentages at lower concentrations. However, cell viability decreases significantly at higher concentrations and after 24 hours. This innovative material holds promise for wound healing, but more research is needed to understand its mechanism of action.

Keywords: Hydrogel, Cannabinoids, Ciclodextrins, Cannabidiol, Cannabinol, Fibroblast, biomaterials, wound treatment.

Restoration of Architectural Objects' Stucco Décor: Ukrainian Experience

Mykola ORLENKO[1], Oleksandr IVASHKO[2,*],
Pavlo BILOUS[2], Anatolii VAKOLYUK[1],
Serhii BELINSKYI[3], Grzegorz TWARDOWSKI[4]

[1]Ukrrestavratsiia Corporation, 6 Boryspilska Street, Kyiv, 02099, Ukraine
[2]Kyiv National University of Construction and Architecture, 31 Povitrianykh Syl Avenue, Kyiv, 03037, 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, Cracow, 31-155, Poland

[*]ghok2233@gmail.com

Abstract. The article is devoted to the restoration of stucco decor on facades and in the interiors of architectural objects. The stylistic features of stucco decor of the second half of the 19th and early 20th centuries are analyzed. The procedure for work is described, which begins with the examination and cleaning of parts from whitewash, dirt, and paint. A separate technology for removing glue and lime, paint and oil layers has been developed. After cleaning, the lost stucco fragment is "plastered" using gypsum mortar, from which the restored fragments are modeled. To restore plaster parts of a complex profile, such parts are first made in a soft material, and then a mold is removed from this model, according to which the plaster addition is cast. For the mold, you can use gypsum or formoplast (synthetic elastic material). The part cast in the mold is attached by gluing to the base using thermoplastics dissolved in organic solvents or water-alcohol solutions of PVA dispersion. If the gypsum part is large, it is attached to the base with nails. During the manufacturing process, the gypsum stucco decor is subject to protective and decorative treatment, which consists of three stages: priming, patination, waxing.

Keywords: restoration, stucco décor, architectural object, Ukraine.

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Revitalization and Reconstruction of the Tenement House at Tuwima 48 in Lodz and the Traditional Architecture of the City

Karol WYSZNACKI[1,*]

[1]Lodz University of Technology Institute of Architecture and Urban Planning, 116 Zeromskiego St., Lodz, 90-924, Poland

[*]karol.wysznacki@p.lodz.pl

Abstract. The article is devoted to the problems of repurposing historical industrial facilities for new functions. The main issues of such measures and the necessary conditions for their feasibility are identified. The existing experience of preserving industrial facilities with a change of function is analyzed and how it can be used in the post-war reconstruction of Ukraine. The main requirements are the location in the centre of large cities with good transport accessibility and residential areas nearby. Examples are given of how new centres of public attraction with an artistic function arise on the site of industrial sites with the preservation of historical industrial buildings.

Keywords: repurposing, industrial architecture monument, modern public space, artistic direction.

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Problems of Repurposing the Monuments of Residential Architecture for Cultural and Artistic Function

Yulia IVASHKO[1,*], Marek PABICH[2],
Volodymyr TOPORKOV[3], Oleksandr KRAVCHUK[1],
Przemysław BIGAJ[4]

[1]Kyiv National University of Construction and Architecture, 31 Povitrianykh Syl Avenue, Kyiv, 03037, Ukraine
[2]Lodz University of Technology, Institute of Architecture and Urban Planning, 116 Żeromskiego Street, 90-924 Lodz, Poland
[3]National University "Yuri Kondratyuk Poltava Polytechnic", 24 Vitaliia Hrytsaienka Avenue, 36011, Poltava, Ukraine
[4]Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31-155, Cracow, Poland

[*]yulia-ivashko@ukr.net

Abstract. The article examines the main problems in repurposing monuments of residential architecture for cultural and artistic purposes: the economic feasibility of repurposing, the negative impact of groundwater and underground communications on the foundations and footings state, the state of the historical object structures, the fine-grained planning scheme that imposes restrictions on changing the purpose of the object for a new function, the emergency state of internal building networks. The main possible directions of such repurposing are identified: a chamber theatre, a thematic museum, a museum of a prominent person, a museum in an open-air museum. Examples of repurposing part of the premises of the former Rodzianko's apartment building at 14-b Yaroslaviv Val Street for a theatrical function and a list of restoration measures carried out are given. The repurposing of the former house of architect Hilary Majewski at 11 Włókiennicza Street in Lodz for a new function is analyzed. The examples of Kyiv museums – the Bohdan and Varvara Khanenko National Museum of Art (formerly the Kyiv Museum of Western and Eastern Art) and the National Museum "Kyiv Picture Gallery" (formerly the Kyiv National Museum of Russian Art) – highlight the peculiarities of the change in traditional museum functions in wartime.

Keywords: problem, repurposing, cultural and artistic function, monument of residential architecture.

Research Work in Developing Design Solutions on the Example of Soil Reinforcement under the Foundations of Supports of Stairs to the Magdeburg Law Monument in Kyiv

Oleksandr MOLODID[1,*], Volodymyr SKOCHKO[1], Olena MURASOVA[2], Ivan REZNICHENKO[3], Olena MOLODID[1], Yevheniia NOVAK[4], Marek POCZĄTKO[5]

[1]Kyiv National University of Construction and Architecture, 31 Povitrianykh Syl Avenue, Kyiv, 03037, Ukraine
[2]State Enterprise "State Research Institute of Building Constructions", 51 Valeriia Lobanovskoho Avenue, Kyiv, 03037, Ukraine
[3]LLC "SPT Ukraine", 14 Hospitalna Street, Kyiv, 01133, Ukraine
[4]Yuriy Fedkovych Chernivtsi National University, 2 Kotsiubynskoho Street, Chernivtsi, 58012, Ukraine
[5]Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31-155, Cracow, Poland

[*]molodid2005@ukr.net

Abstract. The stairs leading to the oldest existing monument in Kyiv – the Magdeburg Law Monument – stretch along the slope of Khreshchatyi Yar. The last reconstruction was carried out in 2013. In 2019, as part of scientific and technical support work for the construction of a pedestrian and bicycle bridge crossing between the parks "Khreshchatyi" and "Volodymyrska Hirka", research work was carried out aimed at securing the soil base under the columns' foundations of the stairs to the Magdeburg Law Monument. Developed scientifically based structural and technological solutions for securing the foundations under the foundations of the staircase columns, which began to shift along the slope during the construction of temporary supports of the pedestrian and bicycle bridge crossing next to them. During experimental studies, the effectiveness of the method of securing soils with polyurethane materials was tested and proven. Design solutions were developed that provide for the injection of polyurethane material through two separate tubes at two elevation levels from the base of the foundation.

Keywords: stairs, Magdeburg Law Monument, restoration work, experimental research, chemical soil consolidation, polyurethane materials, structural and technological solutions, injection.

Re-use of Industrial Heritage as an Element in Achieving Urban Resilience, Adaptation Complex of Textile Industry into a Shopping Centre, Lodz, Poland

Sylwia KRZYSZTOFIK[1,*]

[1]Lodz University of Technology, Institute of Architecture and Urban Planning, 116 Żeromskiego Street, Lodz, 90-924, Poland

[*]sk.3darchitekci@gmail.com

Abstract. Lodz is the fourth most populous city in the country, located in central Poland, a former centre of the textile industry, which has a significant amount of valuable post-industrial heritage. This article presents an example of the adaptation of a complex of 19th century industrial buildings (the former Izrael Kalmanowicz Poznański cotton mill) for commercial functions. The article presents the history of the place and how a new function was implemented on the territory of a former factory with an area of 270,000 m^2 and in former industrial buildings with an area of 9,000 m^2. The methods of adaptation to the new function at different hierarchical levels are described – from the level of the city's master plan to individual industrial buildings and their details. The article presents archival cartographic materials in combination with the changes made and describes different approaches to preserving a historical building. The change is an example of a commercial investment that contributed to the popularization of post-industrial heritage and became an element of building a city brand, emphasizing its post-industrial identity. It is also an element of building a city's resilience that can transform and adapt to changing external conditions.

Keywords: industrial heritage, urban resilience, adaptivility, revitalization, adaptive re-use, Lodz, Manufaktura.

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Polychrome Sculpture in the Interiors of Dunhuang Sanctuaries, its Periodization Abd Artistic-Picture Features

Shiru WANG[1,*], Yuelin WU[1],
Ivan CHORNOMORDENKO[1], Svitlana RUBTSOVA[1],
Bianca BOROS[2], Tomasz KROTOWSKI[3]

[1]Kyiv National University of Construction and Architecture, 31 Povitrianykh Syl Avenue, Kyiv, 03037, Ukraine
[2] "George Enescu" National University of Arts of Iasi, Faculty of Visual Arts and Design, 29 Cuza Vodă St., (Casa Balş), 700040 Iași, Romania
[3] Lodz University of Technology Institute of Architecture and Urban Planning, 116 Zeromskiego Street, Lodz, 90-924, Poland

[*]wangshiru923@163.com

Abstract. Ritual sculpture of Dunhuang is diverse in size (from 30 m to 10 cm). In total, there are more than 3,000 sculptures in the sanctuaries. These are three-dimensional sculptures (most of them), high reliefs, bas-reliefs. To create sculptures from clay, a wooden frame was used, fastened with reeds, with clay coating, grinding, tinting, and painting. Among them are single sculptures, groups/several groups of sculptures, metric rows of identical sculptures. Three periods of sculpture of Dunhuang sanctuaries are distinguished – the period of development (about 180 years), the period of flourishing (about 300 years), the period of decline (about 460 years).

Keywords: Dunhuang, sanctuary, interior, polychrome sculpture, periodization, artistic and figurative features.

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Exploring Innovative Methods for Assessing the Development Potential of Historic Architectural Structures: A Case Study of Small Medieval Towns in Subcarpathia

Anna Maria MARTYKA[1,*]

[1]Department of Architecture and Cultural Heritage, Faculty of Civil and Environmental Engineering and Architecture, Engineering, Rzeszów University of Technology, Al. Powstańców Warszawy 12, 35-959 Rzeszów, Poland

[*]amartyka@prz.edu.pl

Abstract. This article presents an integrated methodology for assessing the development potential of small historic towns with the aim of developing innovative tools to support the conservation and sustainable development of architectural heritage. The proposed research procedure involves a multi-stage process of historical space analysis, the first two stages of which have been tested on the example of medieval towns in the Subcarpathian region, whereas the third stage develops and complements the existing method.The methodology developed not only provides valuable information on the development potential of historic cities but also offers new insights into the protection and adaptation of architecture in the face of contemporary conservation challenges. It enables systematic monitoring of change and evaluation of the effectiveness of conservation efforts, while providing a tool to support sustainable development planning. In addition, through the use of digital technologies, this methodology offers an interactive experience of reconstructing historic architecture. Its universal nature means that it can be successfully applied to architectural heritage research worldwide.

Keywords: architectural heritage, medieval towns, conservation, sustainable development, digital twins.

Revitalization of Historic Districts as a Tool to Enhance Urban Resilience of the City on the Example of Lodz

Sylwia KRZYSZTOFIK[1,*], Aneta Anna TOMCZAK[1]

[1]Lodz University of Technology, Institute of Architecture and Urban Planning, 116 Żeromskiego Street, Lodz, 90-924, Poland

[*]sk.3darchitekci@gmail.com

Abstract. Revitalization is a multifaceted process that must consider spatial, social, and economic conditions. An effective renewal initiative is long-term and requires the various social groups' collaboration, repair programs, and planning documents that incorporate diagnostic results, outline action directions, and establish principles for protection and the transformations' scope. It is also essential to have reliable operational tools integrating planning assumptions, budget, and action schedules, enabling the execution of revitalization projects and enhancing the urban life quality. This article explores the revitalization process in Lodz, a post-industrial city situated in central Poland, which boasts the largest country's area with a valuable historic downtown, dating back to the 19th century. The Lodz Centre Area Revitalization Project stands as Poland's most extensive program in terms of area and budget. Covering a portion of the historic centre spanning 164 hectares, the project received over one billion euros in EU funding. The article details various activities undertaken, the methodologies of their implementation, and the extent of renovations conducted on selected culturally significant buildings. It highlights changes introduced in terms of spatial and functional aspects across multiple scales – district, street, and culturally significant structures. The program has been successfully implemented, with the final investments completed in 2024.

Keywords: adaptation of urban areas, area revitalization, urban living standards, reuse, recover, urban resilience, Lodz.

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Wall Painting as Characteristic Décor of Ukrainian Churches: Experience of the Ukrainian Restoration School

Oleg SLEPTSOV[1], Mykola ORLENKO[2], Pavlo BILOUS[1,*], Tomasz KROTOWSKI[3]

[1]Kyiv National University of Construction and Architecture, 31 Povitrinykh Syl Avenue, Kyiv, 03037, Ukraine
[2] Ukrrestavratsiia Corporation, 6 Boryspilska Street, Kyiv, 02099, Ukraine
[3] Lodz University of Technology Institute of Architecture and Urban Planning, 116 Żeromskiego Street, Lodz, 90-924, Poland

[*]architectpavel@gmail.com

Abstract. The article is devoted to the study of Ukrainian wall painting, which is an integral part of the church interiors (and sometimes facades and monastery walls) since the times of Kyivan Rus. Traditionally, Kyivan Rus fresco and mosaic, Baroque oil wall painting and Baroque carved iconostasis are considered to be the features of decoration that determine the national identity of Ukrainian Orthodox churches. The genesis of the development of the Ukrainian school of Orthodox church construction was repeatedly interrupted, and its revival on new principles began only after the independence of Ukraine. In modern and restored churches of Ukraine, those elements that are expressions of national identity are actively used, which is proven by the examples of modern churches of Cherkasy region, studied by the authors. The study of the execution techniques and restoration technologies of wall paintings of the Kyivan Rus and Baroque periods has proven the high level of skill of ancient masters. These wall paintings are the basis for the modern decoration of Ukrainian churches.

Keywords: wall painting, characteristic décor, experience, Ukrainian school of restoration.

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Regeneration Problems of the Odesa Historical Environment in the Conditions of Post-War Reconstruction

Oleksandr KULIKOV[1,*], Tomasz KROTOWSKI[2]

[1]Kyiv National University of Construction and Architecture, 31 Povitroflotskyi Avenue, Kyiv, 03037, Ukraine
[2]Lodz University of Technology Institute of Architecture and Urban Planning, 116 Żeromskiego St., Lodz, 90-924, Poland

[*]elskrinka@ukr.net

Abstract. It can be predicted that the post-war reconstruction of the historical heritage of Odesa will concern the restoration of individual objects and during the post-war reconstruction of the historical centre of Odesa with objects of different legal status, the following measures will be applied: – restoration based on conservation (for unique objects with the appropriate status, in which authenticity must be maintained); – revitalization, i.e. changing the original function of the object in case of its unprofitability to a new one, which will ensure the economic feasibility of the object while simultaneously preserving the character of the environment; – revalorization, i.e. increasing the level or restoring the properties of the environment, both architectural and aesthetic and artistic, by combining restoration measures for relatively significant objects, if necessary, reproducing lost fragments of buildings or individual objects, removing unaesthetic additions, etc.; – regeneration, i.e. preservation with restoration and improvement of the planning structure of the historical centre.

Keywords: regeneration problem, historical environment, Odesa, post-war reconstruction.

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Selected Problems of Cultural Heritage Protection in a Small Historic Town based on the Example of Głogów Małopolski

Joanna BARTKIEWICZ[1,*], Somayeh AFSHARIAZAD[2]

[1]Department of Architecture and Cultural Heritage, Faculty of Civil and Environmental Engineering and Architecture, Engineering, Rzeszów University of Technology, Al. Powstańców Warszawy 12, 35-959 Rzeszów, Poland
[2]Faculty of Architecture, Cracow University of Technology, Warszawska St. 24, 31-155 Cracow, Poland

[*]jbartkiewicz@prz.edu.plt

Abstract. The article deals with the protection and revalorization of a small historic town, using Głogów Małopolski as an example. Głogów is located in the Podkarpackie Voivodeship, in close proximity to Rzeszów. This town, with its rich history and pedigree in the Renaissance period, currently faces a number of problems in the field of cultural landscape protection and revalorization of the historic center. The authors used research methods such as urban inventory, architectural inventory, photographic inventory, literature and archive research to analyze the historical urban layout of the center, its historic architecture, as well as current forms of conservation protection. On this basis, they diagnosed the biggest problems related to the protection and revalorization of the city's cultural heritage and presented proposals for their solution.

Keywords: Głogów Małopolski, competition for historic city, preservation of historic city, Renaissance urban layout.

Architectural Transformations of Multifamily Housing from 1960–1980 in Poland: Preservation of Detail and the Impact of Thermal Modernization

Dominika CENDA[1], Justyna KOBYLARCZYK[1,*]

[1]Department of Residential Environment Design, Faculty of Architecture, Cracow University of Technology, ul. Podchorążych 1, 30-084 Kraków, Poland

[*]justyna.kobylarczyk@pk.edu.pl

Abstract. The article analyzes multifamily residential architecture from the period 1960–1980, which remains a dominant housing form in many Polish cities. The standardization of architectural solutions and the lack of individual features are now seen as reasons for the low visual appraisal of these buildings. Nevertheless, the uniqueness of some housing complexes was shaped by architectural detailing that introduced individuality into otherwise standardized structures. Due to thoughtful urban planning and proximity to green spaces, this type of development holds significant revitalization potential. Selected case studies illustrate changes in building forms and their surroundings after 1989, highlighting the impact of political and economic transformation. The analysis covered building scale, proportions in relation to the immediate context, facade design, construction solutions, and architectural details—including whether and how original detailing was preserved or transformed as a result of modernization processes. Special attention was given to thermal retrofitting, which significantly altered the visual character of many buildings.

Keywords: multifamily housing, architectural detail, facade aesthetics, housing modernization, post-war architecture.

Renovation and Adaptation of a Historic Modernist Facility to Contemporary Functional and Utility Needs

Nina SOŁKIEWICZ-KOS[1,*], Malwina TUBIELEWICZ-MICHALCZUK[1], Paweł PIETRUSIEWICZ[2]

[1]Czestochowa University of Technology, Faculty of Civil Engineering, Akademicka Street 3, Czestochowa 42-201, Poland
[2]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, al. Armii Krajowej 19, Czestochowa 42-201, Poland

[*]n.solkiewicz@pcz.pl

Abstract. The article addresses the issues of conservation and renovation of historic buildings from the turn of the 19th and 20th centuries, located in the historic areas of the city of Częstochowa (Poland). It discusses actions aimed at organizing the historical urban fabric through a comprehensive approach to the protection of architectural monuments, including their conservation and adaptation to modern functional uses. This process poses a particular challenge in urban areas, where interventions affect well-preserved architectural and urban ensembles of high cultural and historical value. In the context of globalization, the issues of conservation and the use of historic buildings play a key role in shaping local identity and residents' sense of belonging to their place of residence. The article analyzes the practical aspects of renovation and adaptation using the example of a selected historic building – a modernist city villa located in the central part of the city. Due to the building's significance for the city's urban structure, its protection and renewal present a significant challenge for architects and conservation specialists. The article presents an implemented architectural-conservation project, which serves as an example of effective cooperation between institutions and specialists involved in the process of revitalizing cultural heritage areas. The research methods used include the analysis of scientific and professional literature, participant observation, document analysis, and the development of original conservation projects. Based on the conducted research, conclusions were drawn regarding strategies for preserving the identity of a place through the protection of historic buildings and their adaptation to contemporary functional and user requirements.

Keywords: conservation, revitalization of downtown areas, renovation.

Degradation of Polish Manor Houses – Analysis of Technical, Legal and Administrative Factors Influencing the State of Preservation of the Historic Substance

Aleksandra KUŚMIERSKA[1], Mariusz KOSIŃ[1,*], Joanna GONDRO[2]

[1]Czestochowa University of Technology, Faculty of Civil Engineering, Akademicka Street 3, Czestochowa 42-201, Poland
[2]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, al. Armii Krajowej 19, Czestochowa 42-201, Poland

[*]mariusz.kosin@pcz.pl

Abstract. The degradation of Polish manors is a significant problem from the perspective of cultural heritage protection, affecting both the historical landscape and the identity of local communities. Many of these facilities, once important centres of social and cultural life, are gradually deteriorating due to many years of neglect, inappropriate use and limited possibilities for their protection. The article analyses the key technical, legal and administrative factors influencing the state of preservation of the historic substance of these objects. The most common construction problems resulting from many years of neglect, lack of maintenance and improper renovations are discussed. The limitations resulting from the applicable legal regulations concerning the protection of monuments were also analysed, including difficulties in obtaining funds and restrictions imposed by construction and conservation law. The article draws attention to the role of public administration and the effectiveness of the activities of institutions responsible for heritage protection. The conclusion presents proposals for solutions that could help to stop the degradation and improve the state of preservation of Polish manors.

Keywords: protection of cultural heritage, degradation of historical buildings, legal regulations in the protection of monuments, financing the renovation of monuments.

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Conservation and Revitalization of Sacred Architecture in the Second Half of the 20th Century

Aleksandra REPELEWICZ[1,*], Izabela MAJOR[1], Kinga JEŻ[1]

[1]Czestochowa University of Technology, Faculty of Civil Engineering, Akademicka Street 3, Czestochowa 42-201, Poland

[*]aleksandra.repelewicz@pcz.pl

Abstract. The article presents the issue of architecture of the second half of the 20th century in Poland, with particular emphasis on the sacred architecture of that period. These resources, associated in the collective consciousness with the gloomy period of communism in Poland, are not treated as valuable monuments of their era, but are often subject to demolition, devastation and radical transformations. The sacred architecture of this period, created despite very unfavorable conditions, is treated in a slightly different way, being a testimony to the rebellion and determination of a significant part of society. Despite this, churches from the Polish People's Republic (PPR) period, not being treated as historic monuments, are often not preserved and renovated with respect for their original assumptions. Due to the increasing secularization of society, some buildings are currently too large in relation to current needs, which is why the problem of adapting some of these buildings for other purposes begins to arise. These adaptations should be carried out with respect for the basic function of the temple and the original architectural assumptions. The work presents examples of churches from the second half of the 20th century in the Archdiocese of Częstochowa that were subject to this type of interventions.

Keywords: architecture of the second half of the 20th century, sacral architecture, conservation and adaptation of churches.

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Technical and Economic Feasibility Study for the Restoration of a Residential Real Estate Property

Evgeni LANDO[1], A. MURAKHTANOVA[2],
Artem SOPILNYAK[1], Liliia DADIVERINA[3],
Anna JASKOT[2], Damian JOŃCZYK[2,*]

[1]Ukrainian State University of Science and Technologies, Prydniprovska State Academy of Civil Engineering and Architecture, Arkhitektora Oleha Petrova Str., 24A, 49000, Dnipro, Ukraine
[2]TOV Ekspert+, Sicheslavska Naberezhna Str., 15A, office 406, 49102, Dnipro, Ukraine
[3]Dnipro University of Technology, av. Dmytra Yavornytskoho, 19, 49005, Dnipro, Ukraine
[4]Czestochowa University of Technology, Faculty of Civil Engineering, Akademicka Street 3, Czestochowa 42-201, Poland

[*]damian.jonczyk@pcz.pl

Abstract. As a result of the military aggression of the Russian Federation in Ukraine, a large number of buildings and structures have been damaged or destroyed. To restore normal living conditions in areas which were under occupation or in combat zones, it is necessary to take a number of measures: first, damage assessment followed by inspection of damaged buildings, and determination of the resources needed for real estate restoration. Using an example of the property damaged caused by the military aggression of the Russian Federation in Dnipro, an analysis of the economic feasibility or inexpediency of restoring the real estate which has become unsuitable for its intended usage was conducted. An algorithm for determining the economic feasibility/infeasibility of restoring an object has been developed and implemented in Sobornyi district of Dnipro. The developed procedure for assessing the feasibility/infeasibility of restoration can be applied to determine the category of destroyed real estate objects. The calculation results enabled residents of the affected property to get housing certificates for compensation for the destroyed property.

Keywords: economic feasibility, destroyed real estate objects, gross development value, market value.

Renovation of a Sacred Object Made of Limestone, Adapting it to the Conditions of Contemporary Use

Izabela ADAMCZYK[1,*], Jarosław KALINOWSKI[1], Joanna GONDRO[2], Paweł PIETRUSIEWICZ[2]

[1]Czestochowa University of Technology, Faculty of Civil Engineering, Akademicka Street 3, Czestochowa 42-201, Poland
[2]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, al. Armii Krajowej 19, Czestochowa 42-201, Poland

[*]izabela.adamczyk@pcz.pl

Abstract. The paper presents a selected sacral object built of limestone located in the Kraków-Częstochowa Upland in the town of Kalej. It is an interesting object of local religious culture worth recording in the literature due to its unique character and scarce publicly available information about it. The Kraków-Częstochowa Upland is located in southern Poland, in the basin of the upper Vistula and upper Warta rivers, also called the Kraków-Częstochowa Upland, and covers an area of 2615 km2. This area was formed in the Mesozoic era in the Jurassic period and is characterized by the occurrence of sedimentary rocks in the form of limestone. In the area of the Upland, limestone was once the basic building material characterized by high durability and exceptional colors. It was commonly used to build monumental castles, churches, and residential and farm buildings. The paper presents a historical outline of the creation of the sacral object conservation and modernization works performed over the years to adapt it to the current conditions of use and religious worship at a given time.

Keywords: Renovation, limestone, Kraków-Częstochowa Upland, sacral object.

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Renovation of a Post-Industrial Building and Change of its Utility Function

Jacek NAWROT[1,*], Katarzyna BŁOCH[2]

[1]Czestochowa University of Technology, Faculty of Civil Engineering, Akademicka Street 3, Czestochowa 42-201, Poland
[2]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, al. Armii Krajowej 19, Czestochowa 42-201, Poland

[*]jacek.nawrot@pcz.pl

Abstract. Owners of historic buildings whose technical condition is unsatisfactory must make a decision about their future. These buildings were built at a time when different requirements were in force regarding their functionality. In order for them to be used, they must be renovated and the elements that have undergone degradation must be restored. This process is often accompanied by a change in the utility function that allows the building to be used in the current economic realities. This paper presents a methodology for the decision-making process regarding the scope of renovation and reconstruction works on historic buildings, taking into account their new utility program. An example of the renovation of a two-story post-industrial building was presented, for which the previous use was changed. When adapting the building to new operational requirements, the assumption was made to preserve the existing substance of the building to the greatest extent possible, while meeting all structural conditions. It was assumed that most of the visible architectural and construction elements referring to the original character of the building would be restored. The scope and justification for performing individual renovation and reconstruction works are discussed. It has been shown that the applied methodology allows for rational adaptation of the building to current operational requirements while maintaining its original, historic character to the greatest extent possible.

Keywords: post-industrial buildings, historical buildings, renovation works, change of utility program.

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Repairs and Reinforcement of Historic Building Structures Using Brutt Saver Technology

Przemysław KASZA[1], Maciej MAJOR[1,*], Robert MAJEWSKI[2], Marcin NABIAŁEK[3]

[1]Czestochowa University of Technology, Faculty of Civil Engineering, Akademicka Street 3, Czestochowa 42-201, Poland
[2]MaR, Poznańska Street 27, Czestochowa 42-202, Poland
[3]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, al. Armii Krajowej 19, Czestochowa 42-201, Poland

[*]maciej.major@pcz.pl

Abstract. Modern conservation and revitalization of historic buildings require the use of advanced technologies that enable effective structural reinforcement while preserving the historical substance of the object. One of the innovative methods is the Brutt Saver system, which utilizes specialized connectors and techniques for strengthening masonry and structural elements. This article discusses the principles of the Brutt Saver technology, its advantages, and its application in the repair of historic buildings. The study analyzes cases of system implementation in various types of structures, taking into account technical aspects and compliance with conservation requirements. Special attention is given to the possibilities of stabilizing damaged walls, reinforcing masonry joints, and minimizing interference with the original building fabric. In conclusion, the article highlights the effectiveness of the Brutt Saver technology in the long-term protection of heritage buildings, as well as its potential to improve the durability and safety of historic structures. Recommendations for the practical application of this method are also presented, emphasizing the necessity of an individual approach to each building and close cooperation between engineers and conservation authorities.

Keywords: repairs and reinforcement, conservation, renovation, Brutt Saver technology.

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Digitization of Cultural Heritage Resources on the Example of a Sacral Object Using a 3D Laser Scanning System

Przemysław PALACZ[1,*], Paweł KANIA[1], Bartłomiej JEŻ[2], Marcin NABIAŁEK[3]

[1]Czestochowa University of Technology, Faculty of Civil Engineering, Akademicka Street 3, Czestochowa 42-201, Poland
[2]Czestochowa University of Technology, Faculty of Mechanical Engineering, al. Armii Krajowej 19C, Czestochowa 42-201, Poland
[3]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, al. Armii Krajowej 19, Czestochowa 42-201, Poland

[*]przemyslaw.palacz@pcz.pl

Abstract. The article presents the role and process of digitization of cultural heritage resources using the example of the parish church in Borowno, built in 1845–1846. It is an impressive neo-Baroque building, single-nave, with a semicircularly closed presbytery and a two-tower façade. The Trimble X7 3D laser scanning system was used to inventory the facility, which enabled precise mapping of geometry in the form of a point cloud. The obtained data was analyzed in terms of scanning quality, accuracy of mapping architectural details and the possibility of their further use in conservation documentation and 3D modeling. The results of the analysis showed that 3D laser scanning technology is an effective tool for inventorying historic buildings, enabling their detailed analysis and archiving in digital form.

Keywords: architectural monuments, 3D laser scanning system, point cloud, conservation, architectural digitalization, Poland, sacral building, terrestrial laser scanning.

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Leisure Architecture of the 1960s and 1970s as an Example of Post-War Modernism

Barbara ROBAK[1], Justyna KOBYLARCZYK[1,*]

[1]Cracow University of Technology, Faculty of Architecture, 24 Warszawska Street, 31-155 Kraków, Poland

[*]justyna.kobylarczyk@pk.edu.pl

Abstract. The article presents an analysis of recreational centers from the 1960s and 1970s as examples of post-war modernism. Today, these facilities are regarded as a legacy of past eras, embedded in the panoramas of many health spa towns. They are characterized by typical design solutions, both in terms of form-shaping and their relationship with the surrounding environment. Based on selected examples, an analysis was conducted on recreational buildings from the 1960s and 1970s, identifying characteristic elements of their architecture. Subsequently, the transformation processes of these structures were examined, defining the features and solutions that shape their regional character. The study included an analysis of the form of the buildings, their scale, as well as their relationship with the immediate surroundings. Particular attention was paid to the design of building façades and the structural solutions employed.

Keywords: leasure complex, regional architecture, health spa resort, identity architecture.

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Preliminary Design Studies of the Sculptural Decor of a Renaissance House at 23 Rynok Square in Lviv

Svitlana LINDA[1,2,*], Renata PRZEWŁOCKA-SIONEK[3], Oleksandra KULYNSKA[4]

[1]Opole University of Technology, 76 Prószkowska Street, 45-758 Opole, Poland
[2]Lviv Polytechnic National University, 12 Bandery Street, 79042, Lviv, Ukraine
[3]Lodz University of Technology, 116 Stefana Żeromskiego Street, 90-924 Łódź, Poland
[4]Chief architect of the ABMK design office, 7d Naukova Street, 79060, Lviv, Ukraine

[*]svitlana.m.linda@lpnu.ua

Abstract. The Scholtz-Wolfowitz' house at 23 Rynok Square in Lviv is a characteristic monument of Renaissance architecture. The history of its construction is complex and has not yet been fully elucidated. Pre-project studies conducted in 2008, as well as a detailed literary and archival search, allowed us to clarify the periodization of the development of the building's sculptural decoration. Laboratory studies confirmed the stages of formation of the elements of the architectural decoration and polychromy of the tenement house, and their conclusions became the basis for forming the concept of restoration work. This article is devoted to the methodological aspects of pre-project analysis and the development of practical recommendations for the restoration of valuable Renaissance objects in Lviv.

Keywords: preliminary design studies, technological studies, Scholtz-Wolfowiczs' house, Lviv, architecture, Renaissance.

Restoration of Ceilings in Buildings Damaged as a Result of over-Design Impacts, while Preserving the Established Urban Environment

Oleksandr MOLODID[1], Ivan MUSIIAKA[1], Sergey BOGDAN[2], Yehor YASHCHENKO[3], Małgorzta HRYNIEWICZ[4,*], Bartosz MATLAK[4], Ruslana PLOKHUTA[1], Yevheniia NOVAK[5]

[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] National Transport University, 1, M. Omelianovycha-Pavlenka Str. Kyiv, 01010, Ukraine
[4]Cracow University of Technology, 24 Warszawska Street, 31–155 Cracow, Poland
[5] Chernivtsi National University Yu. Fedkovic, 2, Kotsyubynsky Street, Chernivtsi, Ukraine

[*]malgorzata.hryniewicz@pk.edu.pl

Abstract. This article deals with the issue of restoration and modernisation of buildings that have been damaged, inter alia, as a result of warfare. These facilities largely have cultural values and the need to revitalise them is a priority for society. Consequently, it is important to conduct research into the methods of repairing built structures and the results of their implementation. The article considers the issues of restoring inter-floor ceilings damaged due to off-design impacts. These ceilings are most often made of reinforced concrete hollow-core slabs. Existing repair methods do not solve the issue of restoring the structural integrity and geometric parameters of these slabs while at the same time leading to undesirable changes in the spatial and geometric parameters of the building interior. Therefore, finding a way to restore the operational suitability of damaged reinforced concrete hollow-core slabs is an urgent task. The hypothesis of solving the restoring problem of damaged hollow core reinforced concrete slabs by installing reinforcing cages inside the slab voids with the formwork installation inside the voids (damaged areas) and filling the voids with high-fluidity concrete was tested. Experimental studies were conducted to substantiate the possibility of using this method. Based on the data obtained during the experiments, a damaged floor slab was brought into operational condition at one of the construction sites. After operability restoration, this slab has been successfully operated for more than two years, which indicates the correctness of the selected design and technological solutions and the possibility of using this technology to restore the operability of damaged reinforced concrete slabs.

Keywords: over-design impacts, restoration technology, operational suitability, hollow-core slabs, historic heritage.

Facial Recognition for a Vision-Activated Control System

Natalia ANFILOVA[1,*], Marius Daniel MARCU[1],
Florin Gabriel POPESCU[1], Razvan SLUSARIUC[1]

[1]Faculty of Mechanical and Electrical Engineering, University of Petrosani, Universitatii Street, no. 20, zip 332006, Petrosani, Romania

[*]nothing.plus@proton.me

Abstract. The project explores the development and implementation of a Vision-Activated Control System, combining modern Facial Interaction Control Systems (FICS) with embedded hardware control. The theoretical section provides an analysis of facial recognition technologies, including computer vision, machine learning, and human-computer interaction (HCI) principles. It examines the evolution of FICS and discusses their applications in automation, assistive technologies, and other real-world scenarios. The practical section, which is the main focus of the project, details the design and implementation of the Vision-Activated Control System, which utilizes an ESP8266 microcontroller to process and execute real-time commands based on facial gestures and voice input. The facial recognition module detects facial expressions, gaze direction, and blinks, generating signals that are transmitted via HTTP to the ESP8266. These signals control physical outputs, including LEDs, a motor, and an LCD display, enabling seamless communication between the software and hardware components. The project suggests presents a comprehensive analysis of the system's performance, evaluates its accuracy in detecting facial inputs, discusses technical challenges encountered during the development process. The work demonstrates how facial interaction technologies can be effectively integrated with embedded systems to create responsive and intelligent control interfaces, bridging image recognition and electromechanical actions.

Keywords: facial interaction control system, internet of things, human-computer interaction, embedded, machine learning.

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Establishing and Managing Data in Biobank: Sharing Experience for Advancing Biomedical Research

Tatiana MALCOVA[1,2], Raisa PUIA[3,*],
Galina BUTA[4], Mihail TODIRAS[5], Olga TAGADIUC[6]

[1]Nicolae Anestiadi Surgery Department No. 1
[2]Biobank
[3]Nicolae Testemitanu Department of Social Medicine and Management
[4]Department of Family Medicine
[5]Research Center in the Field of Health and Biomedicine
[6]Center of Molecular Medicine
Nicolae Testemitanu State University of Medicine and Pharmacy of the Republic of Moldova, 165 Stefan cel Mare si Sfint ave., MD-2004, Chisinau, Republic of Moldova

[*]raisa.puia@usmf.md

Abstract. The integration and systematization of biomedical data within a research biobank through the implementation of innovative software solutions represents an essential approach for comprehensive information management. This study aims to present the institutional experience in the de novo development of a local tool for integrating associated medical and epidemiological data. Between September 2021 and April 2023, under the framework of the project "Informational Evidence of Biospecimens within the Biobank", coordinated by Nicolae Testemitanu University, a novel in-house biobank management software system "Register for Informational Documentation of Biospecimens within the Biobank" was developed. Furthermore, the software was officially registered as a scientific work, titled "Information Architecture and Systematization of Biospecimens within the Biobank" with the State Agency for Intellectual Property. The system enables comprehensive traceability of biospecimens across the biobanking workflow, including documentation of sample location, analytical procedures, freeze- thaw cycles, shipment, and disposal. Additionally, it facilitates the archiving of essential documentation, such as informed consent and sample collection protocols, while ensuring the protection of personal data. The electronic notebook component is accessible to biobank personnel, researchers, and scientists upon request. A critical phase in validating the in-house IT system involves its technological transfer to other national institutions – both public and private, to foster the development of a standardized and interoperable data collection network (project code: 24.80015.8007.02TT).

Keywords: biomedical research, human biospecimen, data integration, digital infrastructure, data confidentiality.

Study of the Conservation State Using SEM-EDX and XRF Techniques and the Restoration Methodology of a Sucidava-Type Buckle

Ana DROB[1,*], Otilia MIRCEA[2], Viorica VASILACHE[1], Vasile PELIN[3]

[1]"Alexandru Ioan Cuza" University of Iași, Arheoinvest Centre, The Institute of Interdisciplinary Research, 700506 Iași, Romania
[2]Neamț National Museum Complex, Restoration-Conservation Laboratory
[3]"Alexandru Ioan Cuza" University of Iași, Institute for Interdisciplinary Research, Research Center with Integrated Techniques for Investigating Atmospheric Aerosols in Romania (RECENT AIR)

[*]anadrob1@gmail.com

Abstract. In 2020, as a result of systematic archaeological research conducted at Roșiori, Dulcești Commune, Neamț County, a Sucidava-type buckle dating from the 6th–7th centuries AD was discovered. The buckle features openwork motifs–cross, crescent, circles, lines, zigzag–on a shield-shaped plate, revealed post-cleaning. On the reverse, the buckle features three rivets with perforations, two near the base of the loop and one near the terminal knob. This paper presents the findings regarding the artifact's state of preservation, including the types of degradation and deterioration it has undergone, through the application of non-invasive techniques such as stereomicroscopy, SEM-EDX, and XRF. The interdisciplinary investigation aimed to determine the chemical composition, manufacturing techniques, and methods used in creating the decorative features. The analysis identified elements associated with the artifact's composition (Cu, Sn, Zn, and Pb), as well as others absorbed from the burial environment (Si, Mg, and Al). Based on the results, a restoration methodology was developed.

Keywords: fixed-plate Sucidava-type buckle, clothing accessories, SEM-EDX, XRF, restoration and conservation.

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A Meteorologically-Based Model for The Restoration of Areas Affected by Solar Farms

Petar PETROV[1], Veneta STEFANOVA[1,*]

[1]Department of ecology, environmental prtection and restoration, Faculty of Ecology and Landscape architecture, University of Forestry, 10 Kliment Ohridksi, Blvr., 1974 Sofia, Bulgaria

[*]venistefanova3@gmail.com

Abstract. Renewable energy sources are of pivotal importance in the two pillars of climate policies: measures to combat the causes of climate change and measures for adaptation. While there is a broad consensus among scientists that solar energy has the potential to mitigate greenhouse gas emissions, the full extent of the impact of photovoltaic systems on surface energy exchange, near-surface meteorology and biodiversity remains to be fully elucidated. The present study focuses on changes in microclimatic conditions influenced by the construction and operation of a solar park in Bulgaria, and the subsequent possibilities for ecological restoration of the disturbed terrains. The field measurements of selected microclimatic indicators in a solar park were the basis for zoning the park according to the identified impacts. The paper then goes on to propose appropriate methods for the restoration of each zone.

Keywords: solar farm, restoration, degradation.

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Innovative LiDAR-based Exploration of NE Romania's Burial Mounds: High-Resolution Detection and Spatial Analysis in the Jijia River Catchment

Casandra BRASOVEANU[1,*], Andrei ASANDULESEI[1,2], Radu-Alexandru BRUNCHI[1]

[1]Arheoinvest Centre, Institute of Interdisciplinary Research, „Alexandru Ioan Cuza" University of Iași, Romania
[2]Faculty of History, „Alexandru Ioan Cuza" University of Iași, Romania

[*]casandra.brasoveanu@uaic.ro

Abstract. Romania's territory is home to a remarkable concentration of burial mounds, originally constructed from the onset of the Bronze Age and continuously used until the early medieval period. Despite their historical significance, these funerary monuments – particularly those within the Jijia River catchment, an area covering approximately 5,750 km^2 – have remained largely undocumented, with minimal efforts made to understand their chronology or geomorphological context. Our research addresses this critical gap through a pioneering approach that leverages high-resolution airborne sensing technologies to conduct a comprehensive survey of the region. As a result, we successfully identified and documented over 1,600 burial mounds –an unprecedented number that dramatically expands the known inventory of such sites within this area. By precisely mapping and analyzing the micro-morphology of these tumuli, we not only provide vital new insights into their spatial distribution and form, but also generate foundational data to support chronological assessments. The originality and significance of our work are underscored by the fact that many of these monuments are rapidly disappearing due to modern agricultural practices, with numerous mounds already leveled. In this context, our findings represent a crucial step forward in safeguarding and interpreting a vulnerable yet culturally invaluable landscape, offering a transformative contribution to the understanding of funerary practices in Eastern Europe.

Keywords: tumuli, geospatial database, LiDAR, remote sensing, NE Romania.

From Leaves to Learning: an AR Journey into Home Plant Care

Olesea CAFTANATOV[1,*], Inga TITCHIEV[1,*], Arcadie FRON[1,*]

[1]Moldova State University, Vladimir Andrunachievici Institute of Mathematics and Computer Science, Academy street 5, MD2028, Chisinau, Republic of Moldova

[*]olesea.caftanatov@math.md, [*]inga.titchiev@math.md, [*]arcadie.fron@math.md

Abstract. Plant care can be a frustrating experience for many, especially when lacking basic knowledge about the plant's identity and needs. This challenge, often caused by "plant blindness" [1], a tendency to overlook or misidentify plant species affects both novice and seasoned plant enthusiasts. Traditional identification methods, such as books or static images, offer limited engagement and utility. To address this, we propose an innovative mobile augmented reality (AR) application designed to identify home and decorative plants in realtime and provide personalized, comprehensive care guidance. By integrating AR and image recognition technologies, the application allows users to simply point their smartphone at a plant to receive an instant overlay of relevant information. This includes the plant's name, optimal watering schedule, light and soil preferences, common issues, and even interactive 3D models or care videos. Unlike passive resources, this AR solution actively engages users through a hands-on, visual learning experience. The application is developed using platforms such as Unity and Vuforia for its AR functionality. It aims to make plant care intuitive, enjoyable, and educational turning everyday plant ownership into a more successful and rewarding experience.

Keywords: augmented reality, plant blindness, home care plant.

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Surgical Techniques, Prosthetic Technologies, and Innovative Regenerative Materials in the Rehabilitation of Bone Structures for Prosthetic Restorations

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

[1]Faculty of Dental Medicine, Univ.Prof., U.M.F. "Grigore T.Popa" Iaşi, Iasi, Romania
[2]Faculty of Medicine, U.M.F. "Grigore T.Popa" Iaşi, Iasi, Romania

[*]profforna@gmail.com

Abstract. The success of prosthetic restorations, both in dental and orthopedic medicine, relies heavily on the effective rehabilitation of bone structures. Recent advances in surgical techniques and prosthetic technologies are complemented by the development of innovative regenerative materials, which play a critical role in supporting osseointegration, stability, and long-term function. These materials fall into several categories, including autografts, allografts, xenografts, and synthetic substitutes such as calcium phosphate ceramics, bioactive glasses, and polymer-based scaffolds. Key properties such as biocompatibility, osteoconductivity, osteoinductivity, and mechanical strength determine their clinical applicability. In dental implantology, materials like hydroxyapatite coatings or β-tricalcium phosphate are frequently used to promote bone regeneration around implants. Similarly, in orthopedic surgery, bone substitutes are used in procedures like total hip or knee arthroplasty and fracture repair, often in conjunction with metallic prostheses or internal fixation devices. These regenerative solutions not only facilitate anatomical reconstruction but also enhance the integration of prosthetic components, reduce healing times, and improve patient outcomes. The integration of biologically active materials with modern surgical protocols is reshaping the standards of bone rehabilitation and prosthetic reconstruction across medical disciplines.

Keywords: bone regeneration, prosthetic restoration, biomaterials, dental implants, orthopedic prostheses.

Smart Energy Comfort: Optimizing Home Climate with AI and Thermal Inertia

Adriana CATRUC[1,*]

[1]Faculty of Economic Cybernetics, Statistics and Informatics, Academy of Economic Studies of Moldova, 61 Banulescu-Bodoni Street, MD-2005 Chisinau, Republic of Moldova

[*]catrucadriana@gmail.com

Abstract. This study presents an innovative approach to residential energy management through the integration of artificial intelligence (AI) and thermal inertia using water-based storage systems. The proposed system leverages predictive analytics, real-time data from environmental sensors, and efficient heat exchange mechanisms to optimize energy consumption while maintaining superior indoor comfort. By intelligently managing a large insulated thermal storage tank in combination with heat pumps and hydronic distribution systems, the AI-driven system proactively adapts to weather forecasts and household occupancy patterns. In cases where outdoor temperatures fluctuate significantly over short periods (e.g., from -2 °C to 24 °C within a month), the dynamic control significantly reduces indoor temperature variability, thereby improving thermal comfort and energy efficiency. Practical control strategies and operational examples illustrate the system's effectiveness, demonstrating substantial energy savings and improved sustainability for smart homes.

Keywords: thermal inertia, energy management, smart home, predictive control, heat exchange, energy efficiency, artificial intelligence, sustainability.

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Assessment of Cropland CO_2 Emissions and Sustainable Land Use for Climate Change Mitigation

György DEÁK[1,2], Lucian LASLO[1], Natalia ENACHE[1,2,*], Monica MATEI[1], Madalina BOBOC[1], Alexandra CHIRESCU[1]

[1]Department of Climate Change, Sustainable Development and Taxonomy, National Institute for Research and Development in Environmental Protection (INCDPM), Bucharest 060031, Romania
[2]Doctoral School of Biotechnical Systems Engineering, University POLITEHNICA of Bucharest, Romania

[*]natalia_andreea92@yahoo.com

Abstract. An emerging goal in eco-science is represented by the assessment of climate change impact on agricultural performance considering sustainable land-use practices. Thus, monitoring CO_2 emissions from croplands highlights the significant impact of sustainable agricultural practices, underlining the need to reduce the carbon footprint to ensure the ecosystem's sustainability. Through data analysis and modelling, different climatic scenarios can be designed considering the precipitation level and forecasted temperature. Thus, the methodology presented in this study creates a realistic overview of crop productivity, and water and fertiliser requirements for maximizing crop yield, optimizing resource use, preventing plant stress, and considering soil and ecosystem health. Therefore, this research provides a detailed intra-annual analysis of CO_2 emissions in four distinct agricultural parcels with different crops by using a biogeochemical modelling tool. The obtained results highlighted that the maize crop had the highest CO_2 emissions during the growing season under the same climatic conditions, reaching up to 23.4 gm^2h^{-1}, while emissions from the wheat and rapeseed crops were up to 9.9 gm^2h^{-1}. By integrating different scenarios in the Denitrification-Decomposition (DNDC) model, the study highlights the importance of crop management and the application of good practices in reducing GHG emissions and ensuring the sustainability of agricultural systems in Romania.

Keywords: CO_2 emissions, land use, climate change mitigation.

Exploring the Relationship Between Muscle Cramps and Electrolyte Balance Among High School Students

Wei-Jhen CHEN[1,*]

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

[*]eddie@wiipa.org.tw

Abstract. Muscle cramps are sudden and involuntary muscle contractions, often associated with electrolyte imbalances. Electrolytes such as potassium (K^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), and sodium (Na^+) play essential roles in nerve signal transmission and muscle contraction. When the body's ionic balance is disrupted due to dehydration, fatigue, or insufficient intake of key minerals, misfiring of neuromuscular signals may occur, triggering cramps. This study investigates two common types of cramps—exercise-associated muscle cramps and nocturnal leg cramps—and their potential correlations with electrolyte imbalance, physical activity levels, psychological stress, ambient temperature changes, and dietary habits. A survey was conducted among 20 high school students to collect data on lifestyle patterns, food intake, and cramp experiences. The results revealed that students who frequently engage in intense physical activity, lack consumption of magnesium- or potassium-rich foods, experience high stress during exams, and stay up late were more likely to report cramps. Nocturnal leg cramps were also notably associated with colder weather conditions. Although some participants consumed sports drinks, most had limited understanding of the actual physiological functions and effectiveness of electrolytes. This study highlights the importance of understanding the physiological role of ions in maintaining adolescent health. Promoting balanced nutrition, adequate hydration, and effective stress management may help reduce the incidence of cramps. Students are encouraged to engage in further self-directed experiments exploring supplement use and warm-up routines for prevention.

Keywords: muscle cramps, electrolytes, potassium, magnesium, hydration, adolescent health, lifestyle factors.

Use of OTC Medications and Supplements for Premenstrual and Menstrual Symptom Management Among Adolescent Girls

Ting-Yi CHU[1,*]

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

[*]eddie@wiipa.org.tw

Abstract. Premenstrual syndrome (PMS) affects many adolescent girls, presenting with physical and emotional symptoms like abdominal pain, fatigue, irritability, cravings, and sleep issues. These can impact school performance, social life, and overall well-being. Despite its prevalence, education on PMS management is often limited. This pilot study examines teenage girls' behaviors, knowledge, and attitudes toward using over-the-counter (OTC) drugs and supplements during premenstrual and menstrual phases. An anonymous survey was given to 20 female students (ages 15–18), collecting data on substances used, frequency, timing, information sources, and whether they consulted healthcare professionals. Results showed 10% used analgesics before menstruation and 15% during. About 40% used dietary supplements like iron, magnesium, B vitamins, herbal teas, or foods such as chocolate, based on perceived comfort or nutrition. Most relied on online or peer advice, with only 10% consulting a physician or pharmacist. Despite viewing these products as safe, understanding of dosages, interactions, and risks was limited. Some reported using multiple substances without guidance. The findings point to a need for better menstrual health education and medication literacy to support safe self-care. This exploratory study lays groundwork for future research with larger samples and more detailed symptom tracking. While menstrual cramps may be more intense, PMS often causes a wider range of distressing symptoms that deserve equal attention.

Keywords: PMS, menstruation, adolescent girls, self-medication, over-the-counter drugs, supplements, menstrual health, medication literacy.

Analysis of Surface Water Quality and its Impact towards Land Use Activity: A Case Study of Municipal Solid Waste Landfill in Penang, Malaysia

Mohamad Anuar KAMARUDDIN[1], Amy Grace JINOD[1,*], Rasyidah ALROZI[2], Norazian Mohammed NOOR[3]

[1]School of Industrial Technology, Universiti Sains Malaysia, Pulau Pinang, Malaysia
[2]Chemical Engineering Studies, College of Engineering, UiTM Cawangan Pulau Pinang, Pulau Pinang, Malaysia
[3]Faculty of Chemical Engineering Technology, Universiti Malaysia Perlis, Malaysia

[*]anuarkamaruddin@usm.my

Abstract. This study investigates the relationship between leachate discharge (raw leachate, RL, and treated effluent from the final discharge point, FDP) and water quality in Sungai Tengah River (upstream SP1 and downstream SP2) near Pulau Burung Landfill, Penang, using a 10-day dataset. The study was carried out the assess the river water quality of Sungai Tengah with respect to landfill leachate emission entering the water body before flowing into open sea. 4 monitoring stations have been pre-determined prior for sampling procedures. The water samples were analyzed as per American Public Health Association methods, whilst, the river water quality was compared with National Water Quality Standards (NWQS), published by Department of Environment Malaysia. The statistical analysis has shown that the null hypothesis (H_0) found no direct relationship between leachate and river quality, while the alternative (H_a) suggested significant associations. Statistical methods included paired t-tests/Wilcoxon signed-rank tests (SP1 vs. SP2) and Spearman's correlation (FDP vs. SP2), with Bonferroni correction for multiple comparisons. The results revealed significant downstream degradation at SP2 compared to SP1 for total suspended solids, BOD_5, COD, ammoniacal nitrogen, and dissolved oxygen ($p < 0.0083$), rejecting H_0 for these parameters. Moderate positive correlations between FDP and SP2 were observed for COD ($\rho = 0.67$, $p = 0.03$) and ammoniacal nitrogen ($\rho = 0.62$, $p = 0.04$), partially supporting H_a. RL exhibited extreme pollutant levels (e.g., BOD5 = 1214 mg/L) far exceeding river values, but FDP's treated effluent aligned closer to river quality, indicating mitigation. While downstream pollution at SP2 is statistically significant, FDP's influence is limited to specific parameters, suggesting additional pollution sources. The study strengthens the need for enhanced leachate treatment monitoring and expanded RL sampling to better assess long-term impacts.

Keywords: landfill leachate, Pulau Burung Sanitary Landfill, National Water Quality Standards (NWQS), Statistical Analysis.

From Fields to Rivers: Evaluating the Environmental Footprint of Paddy Effluent in Leading Asian Rice-Producing Nations

Muhammad Nasri Nasehir KHAN[1], Mohd Remy Rozainy Mohd Arif ZAINOL[1,*], Najwa Asyillah KASIM[1], Mohd Azmier AHMAD[2], Mohamad Firdaus Mohamad YUSOP[2], Norazian Mohamed NOOR[3], Mohamad Anuar KAMARUDDIN[4]

[1]School of Civil Engineering, Engineering Campus, Universiti Sains Malaysia, 14300 Nibong Tebal, Penang, Malaysia.
[2]School of Chemical Engineering, Engineering Campus, Universiti Sains Malaysia, 14300 Nibong Tebal, Penang, Malaysia.
[3]School of Environmental Engineering, Universiti Malaysia Perlis (UniMAP), P.O Box 77, d/a Pejabat Pos Besar, 01000, Kangar, Perlis, Malaysia.
[4]Environmental Technology Division, School of Industrial Technology, Universiti Sains Malaysia, 11800 Penang, Malaysia.

[*]ceremy@usm.my

Abstract. Paddy cultivation has been one of the major agricultural activities worldwide as over half of the world's population consume rice as a staple food. Countries such as China, Japan, Indonesia and Malaysia are known to be the biggest rice producers in the Asia region with rice production of more than 2 tonnes per year. This review article highlights the effluent quality of paddy plantation in these countries, by comparing the degree of suspended sediment, nutrients and heavy metals. The review found that suspended sediment concentration in paddy fields effluent varied widely across these four countries, with China, Indonesia and Malaysia having the highest concentrations. In terms of nutrients, paddy effluent in these countries was found to contain high levels of total nitrogen (TN) and total phosphorus (TP), which can impair the quality of the receiving water bodies. Heavy metals were dominant in the effluent in all the observed countries. These heavy metals can harm the aquatic organisms and pose risks to human health as entering the food chain. The excessive usage of fertilizers in paddy fields and the conventional cultivation method were the significant sources of pollution in paddy effluent which affect the receiving water bodies. Overall, the review signifies the necessity of better management practices and effective paddy effluent treatment systems to reduce the adverse impact of effluent from paddy plantation to the environment. The findings of this review can be used as guidance for future research and policy initiatives which are aimed at improving the sustainability of paddy cultivation and securing raw water.

Keywords: paddy effluent, suspended sediments, nutrients, heavy metals.

Towards Sustainable Waste Management: Innovations and Research Endeavors at Universiti Malaysia Terengganu

Ruzaidi GHAZALI[1,2,3,*],
Salisa ABDUL RAHMAN[1,2,3],Rohani MUSTAPHA[1],
Siti Norbakyah JABAR[1,2]

[1]Faculty of Ocean Engineering Technology, University Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[2]Energy Storage Research Group (ESRG), University Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[3]Renewable Energy and Power Research Interest Group (REPRIG), University Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia

[*]ruzaidi@umt.edu.my

Abstract. The issue of recycling and waste management has garnered significant attention worldwide, particularly in countries like Malaysia, which is striving for sustainable development. Despite being a developing nation, Malaysia faces challenges in implementing comprehensive waste management practices, especially in the realm of recycling. However, universities and research institutions are actively engaged in research endeavors aimed at addressing this issue. This paper aims to highlight ongoing research activities at Universiti Malaysia Terengganu focused on sustainable waste management practices through various recycling approaches. These approaches involve utilizing diverse waste materials such as biomass, plastics, carbon-based materials, seashells, dead coral, industrial waste, and landfill waste. Techniques such as pyrolysis, composite production, development of new products, and geopolymer material production are being explored and proposed. The sharing of information and ideas through this paper is expected to foster research collaborations and facilitate the dissemination of knowledge at regional levels, thereby contributing to the achievement of Sustainable Development Goals (SDGs).

Keywords: waste management, recycling, pyrolysis, composite, geopolymer, dissemination of knowledge.

K-shape based Time Series Data Clustering for Driving Cycle Development in Ipoh City

Arunkumar SUBRAMANIAM[1], Siti Norbakyah JABAR[1,2,3], Ruzaidi GHAZALI[1,2,3], Salisa ABDUL RAHMAN[1,2,3,*]

[1]Faculty of Ocean Engineering Technology, University Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[2]Energy Storage Research Group (ESRG), University Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia
[3]Renewable Energy and Power Research Interest Group (REPRIG), University Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia

[*]salisa@umt.edu.my

Abstract. In this paper, a new clustering technique for developing driving cycle by using k-shape time series-based is proposed. Driving cycle is important for testing and analyzing vehicle performance, fuel efficiency and emission. Traditional and conventional method of developing driving cycle often rely on manual approaches which can be time consuming, requires high manpower and may not represent the diverse driving patterns accurately. This approach emphasizes the k-shape algorithm specifically designed for time series data. This technique generally groups the similar driving patterns together by identifying the common trends and variations in the real-world driving data. The k-shape algorithm has many advantages and one of the most significant advantages is the ability to eliminate noise, scalable to large datasets and preserves the temporal characteristics of the driving data. By applying the k-shape clustering technique, a more representative and comprehensive set of driving cycle can be obtained in which it reflects the real-world conditions enhancing the reliability of vehicle testing and the accuracy of performance assessments. Lastly, the k-shape algorithm is implemented on the Ipoh city driving cycle data for the clustering of the traffic conditions in Ipoh.

Keywords: k-shape, driving cycle, Ipoh city, DC-TRAD, fuel economy.

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Innovative Simulation-Based Evaluation of Electric Vehicle Performance under Malaysian Urban Driving Conditions

Nur Aida Mohd ADNAN[1], Salisa Abdul RAHMAN[1,2], Che Mohd Ruzaidi GHAZALI[1], Siti Norbakyah JABAR[1,2,*]

[1]Faculty of Ocean Engineering Technology, University Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia
[2]Renewable Energy and Power Research Interest Group (REPRIG), University Malaysia Terengganu, Terengganu, Malaysia

[*]bakyahjabar@umt.edu.my

Abstract. As electric vehicles (EVs) gain traction globally, understanding their real-world performance under diverse urban driving conditions becomes vital, particularly in emerging markets like Malaysia. This study introduces an innovative simulation-based approach using ADVISOR software to evaluate EV efficiency, energy consumption, and powertrain behavior across two localized driving cycles: the Kuala Terengganu Driving Cycle (KTDC) and the Ipoh Driving Cycle (IDC). Both driving cycles were developed through a genetic algorithm-based optimization of actual traffic data, offering a more accurate reflection of Malaysian urban traffic dynamics. The analysis highlights key performance metrics such as motor torque, power loss, battery load, and state-of-charge variations, revealing significant differences in EV behavior under varied urban settings. Results from this study provide critical insights for vehicle manufacturers, urban planners, and policymakers aiming to accelerate sustainable transport adoption in Southeast Asia. The approach also demonstrates a scalable framework for localized EV testing, supporting smart city development and environmental impact mitigation.

Keywords: electric vehicle, driving cycle, EV performance, simulation, ADVISOR.

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The Impact of Climate Change on Food Security in the Republic of Moldova

Alexandru STRATAN[1], Viorica LOPOTENCO[2], Liliana STAVER[3, *]

[1]Department of Management and Enterpreuneurship, Faculty of Business Administration, Academy of Economic Studies of Moldova, 61, Banulescu Bodoni Street, MD-2005, Republic of Moldova
[2]Department of Investments and Banking, Faculty of Finance, Academy of Economic Studies of Moldova, 61, Banulescu Bodoni Street, MD-2005, Republic of Moldova
[3] Centre for Research in Cognitive Science and Technologies (COG-CILIX-NET), Academy of Economic Studies of Moldova, 61, Banulescu Bodoni Street, MD-2005, Republic of Moldova

[*]liliana.condratchi@ase.md

Abstract. Intensified climate change inevitably affects human life and the state of the animal and plant world and becomes a tangible threat to the population's well-being and sustainable development. These factors predetermine the need to consider climate change as one of the key long-term factors of Moldovan food security. In response to this concern, we set out to investigate the impact of climate change on the resilience of food security in the Republic of Moldova. The applied research methodology was based mainly on quantitative methods in the R programming language. Following the analysis, the vulnerability index was constructed for 1997-2023, and the top 5 years with the highest vulnerability were determined. In order to statistically validate the identified critical observations and reduce the complexity in the process of constructing the vulnerability index, the principal components method was applied. The results showed us that 2023 and 1997 are the most vulnerable years. Principal Component Analysis (PCA) reported that climate change explains approximately 80% of the variation, while food security explains 20%. In conclusion, it was found that an increase in vulnerability in recent years indicates that climate pressure is intensifying at a faster pace than the adaptive capacity of the food system of the Republic of Moldova. If the current trend continues, the risk of food insecurity will increase significantly, which justifies the urgency of policies to adapt and strengthen food security resilience.

Keywords: Climate Change Index, Food Security Index, Principal Component Analysis (PCA), Vulnerability Index, Food System Resilience.

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