2nd International Conference on Emerging Technologies in Materials Engineering
EmergeMAT

PROGRAMME and BOOK OF ABSTRACTS

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AVANMAT 2019

2nd EmergeMAT CONFERENCE

EmergeMAT 2nd Conference aims to bring together scientists, engineers, industry representatives and other stakeholders interested in developing new methods, concepts and materials using new and emerging technologies, such as: additive manufacturing, advanced materials for extreme conditions, high pressure and high temperature processes, critical materials and valorisation of new resources.

The 2nd EmergeMAT Conference includes two satellite events.

The Final Conference of the Project INNOVATIVE METHODS FOR ENHANCING HIGH TEMPERATURE THERMAL ENERGY STORAGE PROPERTIES OF PHASE CHANGE MATERIALS - **ENERHIGH,** financed in the frame of Structural Funds - Competitiveness Operational Program – Priority Axis 1-Research, Technological Development and Innovation to support economic competitiveness and business development, Action 1.1.4. Attracting high-level personnel from abroad in order to enhance the R&D capacity, is summarizing some major scientific and technological results obtained for developing encapsulation technologies and demonstrate their effectiveness for future implementation to market steps.

In the third day, a satellite event is organized by **COST Action CA 15102** Critical Raw Materials under Extreme Conditions (**CRM-Extreme**). During Bucharest meeting, the 4 work groups members will discuss major challenges faced by CRM-Extreme Network: substitution, rational use, enhanced recycling of **CRMs**, like Cr, Co, Nb, W, Y, and other rare earth elements, in **high value alloys and metal-matrix composites used under extreme conditions** of temperature, loading, friction, wear, corrosion, in **Energy, Transportation and Machinery manufacturing industries.**

ACKNOWLEDGEMENT

Projects supporting the organization of EmergeMAT 2nd Edition:

ENERHIGH – Innovative methods for enhancing high temperature thermal energy storage properties of phase change materials (ID P_37_776; ctr. 93/2016)

Project co-financed by the Fund for European regional Development in the frame of Operational Program Competitiveness 2014-2020

www.imnr.ro/enerhigh

CRM-EXTREME (CA 15102) – Solutions for Critical Raw Materials under Extreme Conditions

COST is supported by the EU Framework Programme Horizon 2020

www.crm-extreme.eu

PERFORM-MAT – Increased performance and competencies of INCDMNR-IMNR in the field of emerging technologies in materials engineering based on non-ferrous metal (1PFE/2018)

Project financed by the Ministry of Research and Innovation in Romanian

www.imnr.ro/perform-mat

CONFERENCE COMMITTEE MEMBERS

Scientific Committee:

- PhD. Eng. Roxana Mioara PITICESCU, General Manager IMNR, Pantelimon, Romania
- PhD. Alain LARGETEAU, ICMCB-CNRS, Bordeaux, France
- PhD. Antonio RINALDI, ENEA, Rome, Italy
- PhD. Maria Luisa GRILLI, ENEA, Rome, Italy
- PhD. Maria Letizia RUELLO, Università Politecnica delle Marche, Ancona, Italy
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- PhD. Eng. Sorin AXINTE, Politehnica University of Bucharest, Romania
- PhD. Maria Dolores ROMERO-SANCHEZ, Applynano Solutions, Alicante, Spain
- PhD. Eng. Radu Robert PITICESCU, IMNR, Pantelimon, Romania

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- PhD. Eng. Simona Elena BEJAN, IMNR, Pantelimon, Romania
- Eng. Mirela PETRICEANU, IMNR, Pantelimon, Romania

CONFERENCE SPEAKERS

PLENARY SESSION

Roxana Apreutesei
Counselor - Division for Innovation and RDI Infrastructure
Ministry of Research and Innovation
- ***Basic tasks:*** analysis and assessment of the evolution of the national innovation system, correlated to international standards/indicators at European/international level; legislative and operational framework for improving the absorption of RDI results into the economy and promoting Innovation and Technology Transfer entities etc.
- ***Project based tasks:*** *project assisstant – SIPOCA 393 project* aiming at improving the administrative capacity of the Ministry of Research and Innovation (2018-2021)
- ***Main area of expertise:*** public administration (2004 – 2019)

Roxana Mioara Piticescu, scientific researcher I, PhD in Physical Chemistry since 1997, General Director of IMNR since 28 December 2016, she works in IMNR since 1988. She is author of 58 papers (among which 43 ISI papers), 2 book chapters (in Wiley and InTechOpen), 2 books, 15 ISI proceedings, 5 national patents, 54 national patent requests and 2 European patent requests. With a good experience in project management, coordination of the research-development-innovation activities, implementation of the development strategy of the research-innovation activity of the institute, she is Project Manager, Innovation Manager – Code COR 242106, Trainer for trainees (CNFPA), she has a certificate of Knowledge of the requirements of SR EN ISO/ CEI 17025:2005 - management system in laboratory. She is experienced in working at European dimension such as being evaluator in FP 6 Program (DG Research Directorate-NMP), in FP 7 Program-Ideas Program, DG Research Directorate-NMP) and H2020 Programme being contact person from the institute in ETP Nanomedicine, reviewer (PTA) - European Commission, participating in international projects in the frame of FP5, FP6, FP7 and H2020 Programme.

Gabriela Magdalena Pirvu – Co-ordinator of Romanian Cluster Policy Ministry of Economy – Directorate Industrial Policy and Competitiveness Since 2009 involved in designing and promoting the Romanian Industrial/Cluster Policy. Representative of Romania in the Expert Group for Clusters, DG Grow. Project manager SEENECO, financed in Competitiveness Innovation Programme (CIP) of European Commission; cluster excellence and cluster management. Project manager of Project ClusterPoliSEE implemented and funded within INTERREG IVC. Project manager DanuBioValNet – INTERREG Danube. Design and coordination of programmes bi-and multilateral resulted from the agreements with international and European bodies or as a result of Joint Commissions for technical-economic cooperation.

SECTION 1
Thermal energy storage

Dr. Vladimir Popov acts as a Senior Researcher and Head of Additive Manufacturing Center at Technion, Israel. He is an experienced metallurgist who is specialized in metals / ceramics / composites additive manufacturing (EBM, SLM / SLS, Binder Jetting) and characterization of material's mechanical / physical properties and microstructure. The specific topic of Dr. Popov's scientific interests is an adoption, development and application of new structural / functional / and graded materials by additive manufacturing. Among Vladimir's responsibilities, failure analysis of printed parts using SEM / HR SEM / TEM microscopy, fatigue and tensile tests and investigation of fracture surfaces of the fractured samples.

Maria Dolores Romero-Sanchez, Dr. in Chemistry by the University of Alicante. 15 years of experience in the field of nanomaterials and advanced properties of materials, mainly polymers and adhesives for self-cleaning properties, energy efficiency, antibacterial, or thermal energy storage applications. Currently, working in Applynano Solutions, a technological based company in Alicante, Spain, addressed to the production of carbon-based materials such as carbon-nanotubes and graphene, as well as their incorporation into different thermoplastic and thermosetting materials. Also, she is responsible of the coordination of the ENERHIGH project, carried out in the premises of IMNR.

Dr. Markus Meyer studied between 1993-1999 Chemistry and Biology in Bayreuth (Bavaria), Germany, obtaining his diploma with the thesis: Uptake of nitrate, ammonium and organic nitrogen sources by central-European orchids. Between 2000-2003, he successfully wrote the Ph.D. thesis in physical chemistry: Synthesis and characterization of novel silica-gels (Physical Chemistry I in the University of Bayreuth). In the 2003-2008 interval he was Application specialist for DMA (dynamic mechanical analysis), TMA (thermo-mechanical analysis) and DIL (dilatometry) in the laboratory of Netzsch, and from 2008 up to now he is International Sales Manager at Netzsch for Southeast Asia for Netzsch. Almost 1000 different DMA-, Dil- and TMA-projects were done and Dr. Meyer measured about 3400 samples in all fields of materials (polymers, ceramics, metals, composites) during this time.

Ciprian Neagoe, Doctor of Science (2009 – University of Heidelberg), Scientific Researcher, biophysicist, is expert mechanical characterization of biopolymers and microstructures, particularly molecular motors and their applications in medicine. Since 2013 he developed expertise in software simulation of biological and physical processes and applied this to understand some basic mechanisms of energy transport in cardiac cells. From 2016 to 2018 he worked in the software industry as software developer for R&D projects in the fields of simulation technologies and automotive. He is author on landmark original research articles revealing a role for molecular elasticity modulation in heart pathology. Currently he is involved in demonstrating thermal energy storage in innovative phase change materials developed by the IMNR team.

Ioan Albert Tudor, scientific researcher III, PhD in Materials Science since 2017, at Politehnica University of Bucharest. He has been working at IMNR since 2011. He is the author of 15 papers (including 12 ISI papers). He was responsible for 1 national project. He was involved as a key person in several national and international projects. His field of interest is thermal analysis characterization and surface porosity characterization using AFM. Scopus Author ID: 55954157600, ORCID ID: 0000-0003-2964-6764, and Web of Science Researcher ID: Z-1245-2019.

SECTION 2
Additive manufacturing

Eng. Raluca Condruz: Scientific researcher at INCDT COMOTI with bachelor and master degree obtained from University "Politehnica" Bucharest, Faculty of Materials Science and Engineering. Since 2017 she is a PhD student having her thesis in the field of additive manufactured materials by SLM. Expertise: metallic and composite material manufacturing, processing, materials structural and mechanical characterization.

Laura Madalina Cursaru (Popescu), scientific researcher II, PhD in Chemistry since 2008, has been working at IMNR since 2002. She is author of 31 ISI papers, 7 ISI proceedings, 2 book chapters (in Wiley and IntechOpen), 3 national patents, 1 national patent request, 2 European Patent requests. She is Dissemination Coordinator of Cost Action CA16122 BIONECA, Trainer for trainees. She graduated a course of "Expert Accessing European Structural and Investment Funds". She coordinated 4 national projects (in the frame of National Core Programme) and was responsible for 1 national project. She had a postdoctoral fellowship at ICMPP Iasi in Biomaterials field (2010-2013) and was involved as a key person in several international projects. She was member of local organizing committee for scientific workshops or conferences. Scopus Author ID: 25927952300, http://www.researcherid.com/rid/P-8672-2014), ORCID ID0000-0002-3902-5876.

PhD Gheorghe Matache: Senior researcher within INCDT COMOTI since 2010. He holds the Doctor's Degree in the field of Materials Science from University Politehnica Bucharest in 1995. He has competencies in materials science, physical metallurgy, mechanical testing, processes numerical simulation and integration, alloy design and optimization using tools based on thermodynamic calculations and FEA. Achievements in science and engineering of materials relate to development of columnar grains and single crystal turbine blades made in Ni-base superalloys by directional solidification, ceramic coatings for high temperature service as well as in the field of metallurgy and characterization of additive manufacturing of metallic materials.

Wojciech Saletra completed his MSc in Chemistry at Warsaw University in 2007, before moving to Barcelona where he obtained his PhD also in Chemistry from Autonomous University of Barcelona in 2012, while working at Material Science Institute in Barcelona (ICMAB -CSIC). His research area included self-assembly monolayers, machines at nanoscale and crystal structures at negative pressure. After staying in business environment with Fujitsu Technology Solutions and Ricoh came back to work on surface engineering as a Research Associate at Coventry University.

Dr. Antonietta Rizzo is an expert in materials science on surface engineering especially in functional coatings and tribological tests. She coordinates the laboratory of thin films of Brindisi ENEA and directs the activities in the fields of protective coatings made using the most innovative PVD techniques as HiPPMS and Dual Bipolar Magnetron Sputtering.

SECTION 3
Critical materials

Petre Capotă, (born in 1951), Faculty of Physics, University of Bucharest (1970-1975). Degree in Physics – specially Optics – Spectroscopy – Plasma. PhD in Chemistry since 1997. Scientific Researcher IInd degree. Chemical analysis by: Inductively Coupled Plasma – Optical Emission Spectrometry (ICP-OES); FAAS, DCP, Arc/Spark OES, metallographic analysis. Head of analysis laboratory ten years. Quality Responsible for accredited laboratory under SR EN ISO/CEI 17025:2005 by RENAR. Participation in several National, European and International projects.

Dr. Fábio Ferreira completed his university studies in Mechanical Engineering at University of Coimbra (Coimbra, Portugal) in 2013, obtaining a Master's degree with honors. He then received his Ph.D. in Mechanical Engineering at University of Coimbra (Coimbra, Portugal) in 2018. The main objective of his Ph.D. work was to obtain thin films with new and improved properties by taking advantage of the new deposition conditions (bombardment, ionization of sputtered material and control of particles trajectories) available by using HiPIMS. This work involved thin film characterization through several techniques such as nanoindentation, XRD, EDS, SEM, AFM, etc.

Maria Luisa Grilli is Scientist at the Energy Technology Department, ENEA Casaccia Research Centre. She graduated in Physics at the University of Rome "La Sapienza" and received her PhD in Materials Engineering at University of Rome "Tor Vergata" in 2001. Main research topics are design, fabrication by PVD techniques and characterization of interferential coatings for laser and space applications, R&D of coatings for thin film solar cells and optoelectronic devices, R&D of nanostructured materials and metamaterials. She is the coordinator of the Italy-China Great Relevance Project "On demand refractive index for remote sensing" and WGs coordinator within the COST Action "Solutions for critical raw materials under extreme conditions". She is the Italian responsible of the H2020 ERAMIN2 project MONAMIX, "New concepts for efficient extraction of mixed rare earths oxides from monazite concentrates and their potential use as dopant in high-temperature coatings and sintered materials". She is co-author of more than 100 papers in peer reviewed international journals and conference proceedings (citations 1001, H index 18 according to Scopus).

Assoc. Prof. Pavel Novák, Ph.D. is working as an associate professor at the Department of Corrosion Engineering of Institute of Chemical Technology, Prague. Fields of scientific interests include powder metallurgy, intermetallics, tool materials, surface treatment of metals and metallography. He is member of related national and international research societies (European Powder Metallurgy Association, Czech Society for New Materials and Technologies, Association for the Heat Treatment of Metals and Metal Science Society) and editorial boards of Manufacturing Technology journal and The Scientific World Journal. P. Novak is the author of more than 70 publications on WOS and one accepted patent application. The most important research results lie in the optimization of reactive sintering powder metallurgy technology for the synthesis of iron- and titanium-based intermetallics, development of novel high-temperature and wear-resistant intermetallic-based materials and novel titanium-based alloy for porous medical implants.

Lucian Paunescu. Graduate in 1976 of Polytechnic Institute of Bucharest, Metallurgy Department, I worked in the scientific research field since 1978 in Metallurgical Research Institute (Laboratory of Fuel and Energy Saving), Cermax 2000 Patents and Daily Sourcing & Research of Bucharest as well as Junkoeko of Slobozia, covering a wide variety of domains: advanced combustion installations, energy recovery, waste recovery from the metallurgical and glass industries, environmental protection. Since 2011, I have a PhD in Materials Engineering obtained in Valahia University of Targoviste. My activity has been harnessed by 12 patents, two books and over 200 scientific works in Romanian and international journals.

Ewa Rząd, PhD in Chemistry, she graduated PhD studies at the Jagiellonian University in Krakow, the Faculty of Chemistry. She has 7 years of experience in planning, conducting and evaluating the synthesis of new antibacterial drugs and systems for the controlled delivery of active substances (liposomes, polymersomes). She attended in scientific internships abroad (University of Toronto, Max Planck Institute of Colloids and Interfaces, University of Barcelona). She has been working as a scientist at Corrosion Research Center, ŁUKASIEWICZ - Foundry Research Institute in Krakow, Poland since March, 2019. She tests materials in high temperature and oxidation atmosphere.

Prof. Dr. A. Sezai Sarac received his BSc, and MSc in Chem.Eng. from Istanbul Technical University, PhD from Missouri University of Science and Technology, Rolla USA in Chemistry. He held postdoctoral position at University of Leeds and was a visiting professor at MSSI -University of Limerick. He has authored ~300 scientific publications, 8 review articles, book chapters and 2 books, and ~200 conference contributions. He has been awarded from DAAD, DFG, NATO, COST, TUBITAK, and DPT. He is in editorial board of several journals and awarded Doctor (Honoris Causa) in Chemical Sciences from Tajikistan Academy of Sciences (2011). His research interests currently involve conjugated polymers, controlled release systems, functionalized polymeric nanofibers for biosensor construction and tissue engineering scaffolds, polyacrylonitrile based carbon nanofibers and their electrochemical and spectroscopic properties. He has been awarded a number of grants and fellowships from DAAD, DFG, NATO, COST, TUBITAK, Res. State Planning Org.

Prof. PhD. Zara Petkova Cherkezova-Zheleva, - Her research is focused on the material science: preparation, characterization and study of bulk and nanoscale materials; mechanochemistry as a preparation and activation method; Mössbauer spectroscopy, powder X-ray diffraction, relaxation phenomena, chemical environmental problems, green and sustainable chemical processes. She is working also on national and regional politics for strengthening of science and innovations. Dr. Zheleva is Bulgarian National Contact Point in European Research Council, Member of Bulgarian Coordination Council on Nanoscience and Nanotechnology; Board Member of Bulgarian Crystallographic Society. She is involved in organization of more than 30 International Scientific Conferences, Workshops and Schools on Nanosciences, Crystallography, Heterogeneous Catalysis.

SECTION 4
Advanced materials for extreme conditions

Boroica Lucica is senior researcher at National Institute for Laser, Plasma and Radiation Physics, Lasers Department, with more than 33 years of experience in research and development. **Experience:** synthesis and characterization of: special glasses and sealing glasses; refractory for glass industry; colored, opal and technical glasses, vitreous fertilizers for plants, glass ceramics, ceramics, bio-materials, ecological glasses, composites, non-conventional techniques, new methods for materials obtaining such as ultrafast quenching, thin films obtaining and characterization. Teaching activity at University 'Politehnica' Bucharest: Glass technology, Special glasses (in English) and Verre technique (in French).

Peter Klaver received his PhD in computational materials science from Delft University of Technology in 2004, in the area of molecular dynamics simulations of physical vapour deposition of thin films. Since then he has been a postdoctoral researcher for longer than most, with jobs at universities in Northern Ireland, Scotland, the Netherlands and Germany. While the research focus has most often been on atomistic simulation of nuclear materials, it has also included a variety of other subjects, including ionic liquids interacting with solid surfaces, graphene on Cu, Li ion battery materials, H in Pd membranes, and galvanising of steels.

Adriana Gabriela Plăiașu (42 years) is professor in the Department of Manufacturing and Industrial Management, Faculty of Mechanics and Technology, University of Pitesti. Field of interest: science and materials engineering, materials technology, thermal treatments, corrosion and corrosion protection, applied thermodynamics in metallurgy, nuclear materials, and nanostructured materials. She is author of 18 ISI articles, 33 scientific papers with international recognition, and co-author of an application for patent. She participated in more than 5 national research projects and 3 international research projects including two like responsible. Since 2017 she is PD coordinator in Engineering of materials domain.
In 2016-2016 she was director of the Research Institute and then vice-rector, and from 2016 he is director of the Research-development-innovation center of the University of Pitești.

PhD. Eng. Romeu Chelariu, Professor "Gheorghe Asachi" Technical University of Iasi, Faculty of Materials Science and Engineering, Department of Materials Science

Specialist in metallic materials science and engineering. Expertise in the field of non-ferrous alloys: synthesis, casting, plastic deformation, metallic biomaterials, high entropy alloys, metal matrix composites, microstructure, mechanical properties, corrosion.

Prof. Dr. Podgornik Bojan is head of Materials and Technology department at the Institute of Metals and Technology and Professor at the University of Ljubljana. His work is focused on development of advanced metallic materials, surface engineering, deep cryogenic treatment and testing of materials. After defending his Ph.D. in 2000 he spent one year as a post-doc researcher at Uppsala University in Sweden. For his research work he got several awards, including ICM&T best young researcher paper award (1999), American Vacuum Society Bunshah Award (2006), CSHTSE award for outstanding presentation (2013) and best oral presentation award at the 4th TriBaires Workshop (2017). He is an author of about 40 invited, plenary or keynote lectures, 5 chapters in books, more than 150 scientific papers (h-index = 28) and over 300 industrial reports.

Monika Solecka, PhD Eng. in Materials Science, she graduated at AGH University of Science and Technology in 2019. Currently, she works at the Corrosion Research Center, Research Network Łukasiewicz - Foundry Research Institute in Krakow. Her scientific interests focus on materials groups used in the energy industry as well as characterization of materials used scanning and transmission electron microscopy. Furthermore, the field of her research interests are corrosion and erosion resistance of the high temperature materials (like for ex. steels, alloys and protective coatings on Ni-based alloys) used in power plant industry. In her free time, she likes to read books, visit interesting places, play badminton and cook.

PhD. Eng. Sorina-Nicoleta Vâlsan, scientific researcher III, obtained the title of doctor in the field of Process Engineering in 2009, National Higher School of Mine in Saint-Etienne, France. The doctoral thesis theme was "The obtaining of the SOFC peak cell tracking". She is author / co-author in 8 articles (7 ISI articles and 1 BDI article), 1 national patent and 1 book chapter.
Research ID: https://publons.com/researcher/3139471/sorina-nicoleta-valsan/

Arcadii Sobețkii, is a **s**cientific researcher since 2015 at IMNR. He received a Master diploma in photonics and advanced materials at Faculty of Applied Sciences from Politehnica University of Bucharest in 2013. Experience in vacuum technology – operating various PVD equipment with e-beam guns, resistive, cathodic arc, AGD and DC/RF sputtering for thin film depositions by participating in multiple research projects. Obtaining nanoparticles, single, multilayer or co-depositing thin films of different metals and oxides for electronic, optical, medical and high temperature applications like gas sensors, biosensors, mirrors, beam-splitters, antireflective coatings, photocatalytic/antimicrobial coatings, thermal barrier coatings and high entropy alloys.

ROUND TABLE – CHALLENGES IN THE MANAGEMENT AND KNOWLEDGE TRANSFER POC-G PROJECTS

Dr. Eng. Daniela Violeta Dumitrescu has an extensive expertise with over 30 years of experience in the development and recycling of advanced materials, preparation and processing of multicomponent materials and technological transfer to industry Dr. Dumitrescu holds a PhD degree in Materials Science since 2004. Dr. Dumitrescu has valuable experience in the development of eco-technologies with low carbon footprint and limited use of critical metals. In the last decade, she has been focusing on the nonferrous metals waste recycling by melting in MW furnace, as well as the treatment in MW heated thermal filters of the gaseous noxious evolved during the melting of metallic waste. She has coordinated 10 national projects, as project director/responsible, as well as participating in more than 50 projects in environmental engineering, pyrometallurgical, chemical processes, technological transfer and project risk management. Now, she is the director of the structural project TRANSECOTEH-POC- G, which aims for the transfer to industry of the MW technology. Dr. Dumitrescu is author and co-author of 5 books and of more than 70 scientific papers.

CONFERENCE PROGRAM

06.11.2019 (WED)	DAY 1 – ENERHIGH Final Conference
09.00 – 09.30	Registration / Poster setup
09.30 – 09.45	Opening & Welcome
	PLENARY SESSION (*Eminescu Conference Hall*) *Chair: Roxana Mioara Piticescu, IMNR (RO)*
09.45 – 11.15	**Roxana Apreutesei**, **Ministry of Research and Innovation** (RO), PROJECT SIPOCA 393 - CHALLENGES IN IMPLEMENTATION. INNOVATION MANAGEMENT SYSTEM **Sanda Hilgen**, **Ministry of Research and Innovation – OIC** (RO), OPERATIONAL PROGRAM COMPETITIVENESS 2014-2020 **Tudor Prisecaru**, **UPB** (RO), SURFACE ENGINEERING **Flaviana Rotaru**, **ROHEALTH** (RO), ROHEALTH - HEALTH AND BIOECONOMY CLUSTER
11.15 – 11.45	Coffee break
11.45 – 13.15	**Roxana Mioara Piticescu**, Radu Robert Piticescu, Adrian Mihail Motoc, **IMNR** (RO), ROADMAP SPIRE 2050 **Gabriela Pârvu**, **Ministry of Economy** (RO), INDUSTRIAL POLICIES IN ROMANIA **Andreea Paul**, **INACO** (RO), ECONOMY OF THE FUTURE – CURRENT ECONOMIC CHALLENGES **Vladimir. V. Popov**, Evgeny Strokin, Amnon Katz-Demyanetz, Andrey Koptyug, Daniel Safranchik, Menachem Bamberger, **TECHNION** (IL), DEVELOPMENT OF FUNCTIONAL MATERIALS BY POWDER BED FUSION
13.15 – 14.15	Lunch break
	PARALLEL SESSIONS
	Section 1. Thermal energy storage (*Eminescu Conference Hall*) *Chair: Maria Dolores Romero Sanchez, Applynano Solutions (ES)*
14.15 – 15.45	**Maria Dolores Romero-Sanchez**, Radu Robert Piticescu, Ciprian Neagoe, Ioan Albert Tudor, Cristina Florentina Ciobota **IMNR / Applynano Solutions** (RO / ES), MICRO-ENCASPULATION OF INORGANIC PCMs MATERIALS FOR HIGH TEMPERATURE APPLICATIONS **Markus Meyer**, Andre Lindemann, **NETZSCH** (DE), MEASUREMENT OF THE THERMOPHYSICAL PROPERTIES OF PHASE CHANGE MATERIALS USING LASER FLASH METHOD **Ciprian Neagoe**, Ioan Albert Tudor, Cristina Florentina Ciobota, Cristian Bogdănescu, Paul Stanciu, Maria Magdalena Stoiciu, Radu Robert Piticescu, Maria Dolores Romero-Sanchez **IMNR / Applynano Solutions** (RO / ES), STORING THERMAL ENERGY IN SMALL PACKAGES: ADDITIVE PROPERTY OF

	PHASE CHANGE ENERGY STORAGE IN ZINC OXIDE MICRO-ENCAPSULATED SODIUM NITRATE **Ioan Albert Tudor**, Cristian Predescu, Roxana Mioara Piticescu, Radu Robert Piticescu, Maria Dolores Romero-Sanchez, **IMNR / UPB / Applynano Solutions** (RO / ES), INFLUENCE OF DOPANTS ON THE THERMAL PROPERTIES OF NANOSTRUCTURED COMPLEX OXIDES FOR GREEN ENERGY APPLICATIONS
	Section 2. Additive manufacturing (*Rebreanu Conference Hall*) *Chair: Vladimir V. Popov, TECHNION (IL)*
14.15 – 15.45	**Diana Chioibaşu**, Andrei Popescu, **CETAL-INFLPR** (RO), PROTOTYPE ORTHOPAEDIC PROSTHESES 3D PRINTED BY LASER MELTING DEPOSITION (LMD) **Mihaela Raluca Condruz**, Gheorghe Matache, Alexandru Paraschiv, **COMOTI** (RO), CHARACTERIZATION OF IN 625 RECYCLED METAL POWDER USED FOR SELECTIVE LASER MELTING Roxana Mioara Piticescu, **Laura Mădălina Cursaru**, Paul Stanciu, Ana Maria Mocioiu, **IMNR** (RO), INNOVATIVE 3D PRINTING TECHNOLOGIES FOR HYBRID NANOSTRUCTURED MATERIALS PROCESSING **Gheorghe Matache**, Mihai Vlăduț, Alexandru Paraschiv, Raluca Mihaela Condruz, **COMOTI** (RO), EDGE AND CORNER EFFECTS IN SELECTIVE LASER MELTING OF IN 625 ALLOY **Andrei Popescu**, Diana Chioibașu, **CETAL-INFLPR** (RO), PROTOTYPE CRANIAL MESH PROSTHESES FABRICATED BY SELECTIVE LASER MELTING (SLM) **Wojciech J. Saletra**, Edward Cartwright, Liang Wu, Andrew J. Cobley, **Univ. Coventry** (UK), COMPARISON OF CHEMICAL AND ELECTROCHEMICAL POLISHING AS A SURFACE FINISHING METHOD OF AM BUILT 316 STAINLESS STEEL **Antonietta Rizzo**, A.R. Terrizzi, Maurizio Fersini, Antonio Licciulli, **ENEA / UNISALENTO / SALENTEC** (IT), TRIBOLOGICAL STUDY OF INJECTION MOLDED ZTA FOR ORTHOPEDIC IMPLANTS
15.45 – 16.00	Coffee break
	Round Table (*Rebreanu Conference Hall*)
16.00 – 17.00	CHALLENGES IN THE MANAGEMENT OF KNOWLEDGE TRANSFER POC-G PROJECTS *Chair: Daniela Dumitrescu, **IMNR** (RO)*
	Poster presentations (Q&A) / Networking / Conclusions / Discussions **(*Eminescu Conference Hall*)** *Chair: Radu Robert Piticescu, IMNR (RO)*
16.00 – 17.00	1) **George Barjoveanu**, Carmen Teodosiu, Andra Predescu, Ecaterina Matei, Cristian Predescu, **TU Iasi / UPB** (RO), ENVIRONMENTAL ASSESSMENT OF FeO3@TiO2 NANOPARTICLES SYNTHESIS 2) **Cristina Ioana Bănică**, Denisa Vonica, Beatrice Șerban, Lidia Licu, Mihai Tudor Olaru, Florentin Stoiciu, Viorel Bădiliță, **IMNR** (RO), THE DESIGN OF A NEW LOW WEIGHT HIGH ENTROPY ALLOY

3) **Cristina Florentina Ciobota**, Ioan Albert Tudor, Simona Elena Bejan, Anca Elena Slobozeanu, Radu Robert Piticescu, Laura Eugenia Bărbulescu, Dumitru Valentin Drăguț, **IMNR** (RO), HYDROTHERMAL SYNTHESIS OF MULTICOMPONENT RARE EARTH OXIDES
4) **A.C. Costache**, C. Curuţiu, Gabriel Moagăr-Poladian, C. Obreja, Oana Tutunaru, Antonio Rădoi, **IMT / UPB** (RO), WASTE FROM POLYMER SELECTIVE LASER SINTERING AND ITS IMPACT ON ENVIRONMENT: HOW TO DO INITIAL DECONTAMINATION
5) **Laura Mădălina Cursaru**, Roxana Mioara Piticescu, Ioan Albert Tudor, Ana Maria Mocioiu, Dumitru Valentin Drăguț, **IMNR** (RO), THERMAL INVESTIGATION OF IRON OXIDE NANOMATERIALS. THE INFLUENCE OF SYNTHESIS PARAMETERS ON STRUCTURAL PROPERTIES
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8) **Ion Frăţilescu**, Diana Anghel, Anca Lascu, Eugenia Făgădar-Cosma, **ICT** (RO), WATER SOLUBLE PORPHYRIN DERIVATIVES USED IN PLATINUM RECOVERY
9) **Laura E. Geambazu**, Ioana Csaki, Sigrun Nanna Karlsdottir, Victor Geantă, **UPB / Univ. Iceland** (RO / IS), CoCrFeNiMo HIGH ENTROPY ALLOY BEHAVIOUR IN GEOTHERMAL ENVIRONMENT
10) **Mihai Ghiță**, Alexandra Georgiana Vătui, Antoneta Constantina Filcenco-Olteanu, Marian Burada, Daniel-Cristian Mihăiescu, Sorina Nicoleta Vâlsan, Ionuț Măcărescu, Mihai Tudor Olaru, Petre Capotă, Florentin Stoiciu, Dumitru Valentin Drăguț, **IMNR** (RO), SCIENTIFIC RESEARCHES AND TECHNOLOGICAL DEVELOPMENTS FOR THE EFFICIENT USE OF SECONDARY METALLIC RESOURCES
11) **Giosuè Chiara.**, Mobili A., Citterio B., Biavasco F., Maria Letizia Ruello, Tittarelli F., **UNIVPM / UNIURB / ISAC-CNR** (IT), INNOVATIVE FINISHES FOR THE IMPROVEMENT OF INDOOR AIR QUALITY
12) **Viorel Ionescu**, **Univ. Ovidius** (RO), NUMERICAL MODELING OF MIXED-MODE DELAMINATION FRACTURE IN UNIDIRECTIONAL AS4/PEEK COMPOSITES
13) **Aleksandra Ivanovic**, Jasmina Novakovic Grbovic, Silvana Dimitrijevic, Stevan Dimitrijevic, **MMI BOR / Univ. Belgrade** (RS), KINETICS OF COBALT NITRIC ACID LEACHING FROM DIAMOND CORE DRILLING CROWNS
14) **Vjaceslavs Lapkovskis**, Viktors Mironovs, **RTU** (LV), RUBBER CONVERSION VIA DEVULCANISATION AND ITS FURTHER PROCESSING INTO COMPOSITE MATERIALS SUITABLE FOR ENVIRONMENTAL APPLICATIONS
15) **Claudio Larosa**, Attilio Converti, **Univ. Genoa** (IT) QUARTZ CRYSTAL MICROBALANCE COUPLED TO ASSIST THE MULTILAYER PROTEIN ASSEMBLY BY LANGMUIR BLODGETT TECHNIQUE
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17) **Lidia Licu**, Petre Capotă, **IMNR** (RO), DETERMINATION OF CHEMICAL COMPOSITION AND LAYERS THICKNESS BY ICP-OES
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CONSTRUCT (RO), ADVANCED Ti-Al-N WEAR RESISTANT COATINGS PRODUCED BY REACTIVE DC MAGNETRON SPUTTERING

19) **Ciprian A. Manea**, Ioana Csaki, Sigrun Nanna Karlsdottir, Victoraș Geantă, **UPB / Univ. Iceland** (RO / IS), THE BEHAVIOR OF AlCrFeNiMn HIGH ENTROPY ALLOY IN GEOTHERMAL STEAM
20) **Cornelia Marinescu,** Ancuța Sofronia, Cornel Munteanu, Maria Marcu, Fuad Khoshnaw, Cristina Florentina Ciobota, Speranța Tănăsescu, Elisabeta Mirela Cojocaru, **ICF / De Montfort Univ. / IMNR / UPB** (RO / UK), PHASE TRANSFORMATIONS AND MICROSTRUCTURE EVOLUTION IN FERRITE-AUSTENITE BASED ALLOY
21) **Maria Marinescu**, Ludmila Otilia Cinteză, Cristina Stavarache, Christina-Marie Zălaru, Marcela Popa, Mariana-Carmen Chifiriuc, **Univ. Bucharest / ICO / ICUB** (RO), NOVEL PYRAZOLONES AS ANTIMICROBIALS
22) **Maria-Roxana Marinescu**, Bogdan-Cătălin Șerban, Cornel Cobianu, Nicolae Dumbrăvescu, Octavian Ionescu, Octavian Buiu, **UPB / IMT** (RO), CARBON BASED MATERIALS FOR SENSORS USED IN BIO(MEDICAL) APPLICATIONS
23) **Alina Matei**, Bianca Cătălina Țîncu, Oana Tutunaru, Vasilica Țucureanu, **IMT / UPB** (RO), SYNERGETIC EFFECT OF ZnO – RESIN EPOXY NANOCOMPOSITES COATINGS FOR ADVANCED APPLICATIONS
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25) **Sabin Mihai**, Diana Chioibașu, Andrei Popescu, Marc Leparoux, **CETAL-INFLPR / EMPA** (RO/ CH), BEHAVIOR OF AN ALUMINUM BASED METAL MATRIX NANOCOMPOSITE DURING IRRADIATION WITH HIGH POWER LASER PULSES
26) **Ana Maria Mocioiu**, Oana Cătălina Mocioiu, Laura Mădălina Cursaru, **IMNR / ICF** (RO), 3D STRUCTURES OF SiO_2-ZnO MATERIALS OBTAINED BY SOL-GEL ROUTE WITH OPTICAL AND ANTIBACTERIAL PROPERTIES FOLLOWED BY 3D PRINTING
27) **Oana Cătălina Mocioiu**, Diana Irinel Băilă, Ana Maria Mocioiu, **ICF / UPB / IMNR** (RO), THIN FILMS DEPOSITION ON GLASS USING E-GUN TECHNOLOGY FOR MEDICAL APPLICATIONS
28) Mihai Oane, Monica R. Nemțanu, **Mirela Brașoveanu**, Daniel Ighigeanu, **INFLPR** (RO), THERMAL DISTRIBUTION IN MATERIALS IRRADIATED IN THE RELATIVISTIC ELECTRON FIELD
29) **Mihai Oane**, Bogdan Sava, Ion N. Mihăilescu, Lucica Boroica, Dorina Ticoș, Adrian Scurtu, Cătălin M. Ticoș, **INFLPR** (RO), A NEW COMPUTATIONAL MODEL FOR DESCRIPTION OF THE FUSION PROCESS FOR A MICRO/NANO SIZES TUNGSTEN SPHERE UNDER POWERFUL LASER IRRADIATION
30) **Rovena Pascu**, Andreea Matei, Bogdan Sava, Alexadra Trefilov, **INFLPR** (RO), FABRICATION BY PLD OF 20%Sm-DOPED CERIA/ 20%NI-SDC THIN FILMS SUBANSABLY OF ELECTROCHEMICAL DEVICES FOR LOW AND INTERMEDIATED OPERATING TEMPERATURE
31) **Mattia Pierpaoli**, Aneta Łuczkiewicz, Sylwia Fudala-Książek, Robert Bogdanowicz, Maria Letizia Ruello, **UNIVPM / GUT** (IT / PL), CARBON NANOMATERIALS AS CRM-FREE ELECTRODES FOR THE LEACHATE ELECTROCHEMICAL OXIDATION
32) **B.O. Postolnyi**, R.F. Webster, R.D. Tilley, V.M. Beresnev, L. Rebouta, J.P. Araújo, A.D. Pogrebnjak, **U.Porto / Sumy Univ. / UNSW / Kharkiv Univ. / U.Minho** (PT / UK / AU) MULTI-LAYERED STRUCTURES OF METAL NITRIDE HARD COATINGS AS A SOLUTION FOR CRITICAL RAW MATERIALS PROBLEM
33) Maria Tănase, Marin Micuț, Adina Răducan, Cristina Scomoroscenco, Cristian Petcu, Cristina Lavinia Nistor, Elvira Alexandrescu, Laura Chirilă, Ioana Rodica Stănculescu, **Ludmila Otilia Cinteză**, **Univ. Bucharest / ICECHIM / INCDTP**

	/ **IFIN-HH** (RO), FACILE SYNTHESIS OF SUPERAMPHIPHOBIC COATINGS FOR TEXTILES WITH SPECIAL WETTABILITY 34) **Hamdi Tekin**, **Istanbul Arel Univ.** (TR), RECYCLING OF CRITICAL RAW MATERIALS: A CASE OF TURKEY 35) **Alexandra M.I. Trefilov**, Adriana E. Bălan, Lucica Boroica, Bogdan A. Sava, Bogdan Biță, Sorin Vizireanu, Gheorghe Dinescu, **INFLPR / Univ. Bucharest** (RO), PLASMA FUNCTIONALIZED CARBON NANOWALLS FOR PEM FUEL CELL APPLICATIONS 36) **Oana Tutunaru**, Carmen Mihăilescu, Anton Ficai, **IMT / UPB** (RO), GLUCOSE DETECTION USING PEDOT BIOACTIVE LAYER 37) **Bianca Țîncu**, Andrei Avram, Marioara Avram, Vasilica Țucureanu, Alina Matei, Cătălin Mărculescu, Tiberiu Burinaru, Florin Comănescu, Oana Tutunaru, Ioana Demetrescu, **IMT / UPB / USAMV** (RO), THE STRUCTURAL MODIFICATION OF SINGLE LAYER GRAPHENE BY OXYGEN PLASMA TREATMENT 38) **Vasilica Țucureanu**, Alina Matei, Ioan Albert Tudor, Dumitru Valentin Drăguț, Laura Mădălina Cursaru, Daniel Munteanu, **IMT / IMNR / UNITBV** (RO), OPTICAL PROPERTIES OF Au-YAG:Ce,Gd/PEDOT-PSS NANOCOMPOSITE 39) **Nicoleta Vitan, Lidia Licu, Petre Capotă, IMNR (RO)** QUANTITATIVE PHASE ANALYSIS OF CHEMICAL COMPOUNDS, CARRIED OUT BY ICP-OES 40) **Mehmet Yilmaz**, Maria Luisa Grilli, **Ataturk Univ. / ENEA** (TR / IT), THE EFFECT OF Li CONTENT ON THE STRUCTURAL PROPERTIES OF ZnO 41) **Christina Zălaru**, Florea Dumitrașcu, Constantin Drăghici, Ludmila Otilia Cinteză, Maria Marinescu, Isabela Tracomnicu, Marilena Cimpoeșu, Rodica Tatia, Lucia Moldovan, **Univ. Bucharest / ICO / Cytogenomic Medical Laboratory / INCDSB** (RO), NOVEL SUBSTITUTED HETEROCYCLES HYBRIDS WITH ANTI-TUMOR ACTIVITIY
07.11.2019 (THU)	**DAY 2**
08.00 – 13.00	Visit to IMNR laboratories
09.00 – 09.30	Registration
	Section 3. Critical materials – COST Action CRM-EXTREME **(*Eminescu Conference Hall*)** *Chair: Maria Luisa Grilli, ENEA (IT), CRM-EXTREME WGs Coordinator*
09.30 – 10.50	**Silviya Boycheva**, Denitza Zgureva, Hristina Lazarova, Katerina Lazarova, Tsvetanka Babeva, Margarita Popova, **TUS / BAS** (BG), PROCESSING OF HIGH-GRADE ZEOLITE COMPOSITES FROM SOLID FUEL COMBUSTION BY-PRODUCTS AS CRYTICAL RAW MATERIALS SUBSTITUTES **Petre Capotă**, Eleonora Ana Neagu, Victoria Purcaru, Lenuța Enache, **IMNR** (RO), INTERNATIONAL COOPERATION IN CHEMICAL CHARACTERISATION OF NONFERROUS AND FERROUS ALLOYS **Fábio Ferreira**, Ricardo Serra, Albano Cavaleiro, João Oliveira, **Univ. Coimbra / LED&Mat-IPN** (PT), CORRELATION BETWEEN SUBSTRATE ION FLUXES AND PROPERTIES OF HIPIMS-DLC FILMS USED IN INTERNAL COMBUSTION ENGINES **Maria Luisa Grilli**, D. Valerini, G. Hu, C. Song, A. Nematpour, R. Chierchia, A. Rizzo, A. Rinaldi, M. Yilmaz, **ENEA / CAS / Ataturk Univ.** (IT / CN / TR), A COMPARATIVE STUDY OF THE MECHANICAL PROPERTIES OF Al_2O_3 COATINGS FABRICATED BY ATOMIC LAYER DEPOSITION AND RADIO FREQUENCY SPUTTERING

	Antonio J. Sala Candela, **UPM** (ES), METAL FIBER BRUSHES AS A SUBSTITUTE OF GRAPHITE AND AN INNOVATIVE APPLICATION
10.50 – 11.20	Coffee break
11.20 – 13.00	*Chair: Maria Letizia Ruello, UNIVPM, (IT), CRM-EXTREME Chair* **Pavel Novák**, A. Knaislová, A. Školáková, P. Salvetr, F. Průša, M. Cabibbo, L. Jaworska, **UCT / UNIVPM / IOS** (CZ / IT / PL) INTERMETALLICS AS CRM SUBSTITUTES IN AUTOMOTIVE AND AEROSPACE INDUSTRY **Lucian Păunescu**, Marius Florin Drăgoescu, Sorin Mircea Axinte, Ana Casandra Sebe, **Junkoeko / Daily Sourcing & Research / Cosfel Actual** (RO), POROUS CERAMIC MATERIAL WITH HIGH MECHANICAL STRENGTH MADE FROM CLAY WASTE AND COAL ASH USING THE MICROWAVE ENERGY **Ewa Rzad**, Monika Solecka, Danuta Chmielewska, Barbara Synowiec, Artur Ozieblo, Pawel Pichniarczyk, Tomasz Dudziak, **ŁUKASIEWICZ RN** (PL), EFFECT OF CERAMIC BASED COATINGS DEPOSITED ON LOW ALLOYED STEEL 10H2M EXPOSED AT HIGH TEMPERATURE IN AIR OXIDATION CONDITIONS **A.Sezai Sarac**, **ITU** (TR), GOLD - CONJUGATED POLYMER NANOCOMPOSITES FOR BIOMEDICAL APPLICATIONS **Zara Cherkezova-Zheleva**, D. Paneva, H. Kolev, M. Tsvetkov, E. Encheva and G. Stefanov, **BAS / UNIV. SOFIA** (BG) REUSE OF Fe-BASED AMORPHOUS ALLOYS CONTAINING CRM FOR WASTEWATER REMEDIATION
13.00 – 14.00	Lunch break
	Section 4. Advanced materials for extreme conditions ***(Eminescu Conference Hall)*** *Chair: Bojan Podgornik, IMT (SI)*
14.00 – 15.40	Bogdan Alexandru Sava, **Lucica Boroica**, Ileana Cristina Vasiliu, Elisa Mihail, Alexandra Trefilov, Ana Filip, Oana Gherasim (Fufa), **INFLPR / INOE 2000** (RO), GRAPHENE AND OXIDE GRAPHENE COMPOSITE WITH PHOSPHATE GLASS **T. P. C. Klaver**, M. H. F. Sluiter, B. Podgornik, A. Gustin, D. Mitrică, R. Piticescu, **TU Delft / IMT / IMNR** (NL / SI / RO), HIGH THROUGHPUT SCANNING WITH A CALPHAD DATABASE FOR HIGH TEMPERATURE BCC HIGH ENTROPY ALLOYS **Roxana Mioara Piticescu**, Lars Österlund, Dumitru Ulieru, Janusz Smulko, Jan Mitrovics, Mohamed Fethi Diouani, Benachir Bouchikhi, Radu Ionescu, **IMNR / Molecular Fingerprint Sweden AB / Sitex 45 / GUT / JLM Innovation / Institut Pasteur de Tunis / Univ. Moulay Ismail / Uppsala Univ.** (RO / SE / PL / DE / TN / MA), DEVELOPMENT OF A NON-INVASIVE BREATH TEST FOR EARLY DIAGNOSIS OF TROPICAL DISEASES **Adriana-Gabriela Plăiașu**, Marian Cătălin Ducu, Sorin Georgian Moga, Aurelian Denis Negrea, Ecaterina Magdalena Modan, Ion Pătrașcu, **UPIT** (RO), NANOSTRUCTURED TRANSITION METALS OXIDES **Romeu Chelariu**, Victoraș Geantă, Nicanor Cimpoiesu, Bogdan Istrate, Ioan Carcea, Raluca-Maria Florea, **TUIASI / UPB / Rancon**, RESEARCH ON MULTICOMPONENT ALLOYS FROM THE FeCrNiMn-X SYSTEM FOR EXTREME USE CONDITIONS

15.40 – 16.00	Coffee break
16.00 – 17.00	*Chair: Adriana-Gabriela Plăiașu, UPIT (RO), CRM-EXTREME MC Member* A. Penalva García, B. Calderón Roca, **Maria Dolores Romero Sánchez**, I. Rodríguez Pastor, I. Martín Gullón, **Applynano Solutions** (ES), CARBON BASED NANOPARTICLES FOR APPLICATIONS IN THE TRANSPORT SECTOR: AUTOMOTIVE AND AERONAUTICS COMPONENTS **Bojan Podgornik**, Agnieszka Kračun, Borut Žužek, F. Tehovnik, **IMT** (SI), NANO-PARTICLES REINFORCED STEELS FOR EXTREME WORKING CONDITIONS **Monika Solecka**, Ewa Rząd, Grzegorz Golański, Paweł Wieczorek, Tomasz Dudziak, **ŁUKASIEWICZ RN / CUT** (PL), MATERIALS FOR ENERGY APPLICATIONS: CHARACTERISATION OF THE AUSTENITIC STEELS AFTER AIR AND STEAM OXIDATION **Sorina-Nicoleta Vâlsan**, Dumitru Valentin Drăguț, Mircea Corban, Maria Luisa Grilli, Antonio Rinaldi, Daniele Valerini, Felix Balima, Mythili Prakasam, A. Largeteau, Radu Robert Piticescu, **IMNR / ENEA / CNRS** (RO/ IT / FR), DESIGN, OBTAINING AND CHARACTERIZATION OF NEW MATERIALS BASED ON ZIRCONIA DOPED WITH MIXED RARE EARTH OXIDES **Arcadii Sobetkii**, Laurențiu Moșinoiu, Mircea Corban, Victor Manoliu, Mihai Boțan, G. Ionescu, Bogdan Vasile, R. Trusca, A. Surdu, Radu Robert Piticescu, **IMNR / INCAS / UPB** (RO), ZIRCONIUM PEROWSKITES AS NOVEL MATERIALS FOR HIGH TEMPERATURE COATINGS DEVELOPED THROUGH COMBINATORIAL EB-PVD DEPOSITION TECHNOLOGY
17.00 – 17.15	**Poster session awards for young scientists (*Eminescu Conference Hall*)** *Chair: Radu Robert Piticescu, IMNR (RO)*
08.11.2019 (FRI)	**DAY 3 – Satellite event COST Action CRM-EXTREME (CA15102)** **(*Eminescu Conference Hall*)**
09.00 – 09.30	Registration*
09.30 – 10.00	Report on the Action's activities (state of the art and incoming steps)
10.00 – 10.50	In-depth analysis of the researches presented in "Session 3. Critical materials" Flash talks of the authors of posters and presentations
10.50 – 11.20	Networking Coffee Break
11.20 – 13.00	In-depth analysis of the researches presented in "Session 3. Critical materials" Question/Answer session with the authors of posters and presentations
13.00 – 14.00	Networking Lunch Break
14.00 – 15.40	Round table for work proposals on the researches presented
15.40 – 16.00	Closing remarks

) Event open only for registered COST Action participants.

CONFERENCE ABSTRACTS
SECTION 1. THERMAL ENERGY STORAGE

DEVELOPMENT OF FUNCTIONAL MATERIALS BY POWDER BED FUSION

V. V. Popov[1], E. Strokin[1], A. Katz-Demyanetz[1], A. Koptyug[2], D. Safranchik[1], M. Bamberger[3]

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The current research presents experimental findings in Powder Bed Fusion of Functional materials.
Functional materials by 3D printing are considered to represent next generation of "4D printing". That means that together with complex geometry and high mechanical properties, additional physical (functional) properties can be provided by additive manufacturing.
Powder Bed Fusion (PBF) is a type of 3D printing where the powder is deposited layer-by-layer, and then fused according to cross-section of the model in specific regions of the powder layer.

In current research are demonstrated possibilities of the three main PBF-techniques: Selective Laser Melting (SLM), Electron Beam Melting (EBM) and Binder Jetting Printing (BJP) [1]. All of these techniques have unique benefits for producing functional materials like shape-memory alloys, high entropy alloys [2], magnetic materials [3], composite-based materials for high temperature applications [4], etc.

All experiments were carried out at Israel Institute of Metals (Technion R&D Foundation) in Arcam EBM, EOS M290, and ExOne M-Flex machines. All these machines were modified for the work with small amounts of powder that is crucial for experiments with new powder materials by additive manufacturing.

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MICRO-ENCASPULATION OF INORGANIC PCMs MATERIALS FOR HIGH TEMPERATURE APPLICATIONS

Maria Dolores Romero-Sánchez[1,2], Radu Robert Piticescu[1], Ciprian Neagoe[1], Ioan Albert Tudor[1], Cristina Florentina Ciobota[1]

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Molten salts (i.e. KNO_3, $NaNO_3$ and eutectics) are interesting PCMs studied for high temperature storage applications (>200 ºC). They have suitable physical (melting temperature, specific heat) and chemical properties, as well as cost issues. However, the lack of compatibility with containers where included, mostly produces corrosion problems and the mass loss produced during thermal cycles (poor thermal stability) leads to a decrease in the thermal energy storage capacity. Encapsulation processes of the PCMs are proposed as a solution to avoid these limitations.

Conventional macro-encapsulations of high temperature PCMs (melting temperatures higher than 300 ºC), such as molten salts or metals, cover mm size, whilst micro-encapsulations (μm or nm scale) are being studied in literature in the last few years but not commercially available till now, under our knowledge. Some advantages of micro-encapsulations for thermal energy storage applications include the reduced expansion/contraction process, increased resistance to corrosion, high surface area for heat exchange and/or sub-cooling reduction and segregation problems.

The particle size, type and thickness of shell and microparticles geometry are determinant for the efficiency and performances of microencapsulated PCMs (i.e. heat transfer rate, thermal conductivity). Modelling the thermal behavior of individual components and find optimal configuration that corresponds to the specific configuration was done by the finite element method (FEM), allowing to dynamically show the thermal properties of the system, compare different designs, and indicate optimizations. The results were used to model the thermal properties of micro-encapsulated PCMs and test their functional properties on a special designed pilot tank.

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MEASUREMENT OF THE THERMOPHYSICAL PROPERTIES OF PHASE CHANGE MATERIALS USING LASER FLASH METHOD

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The laser flash method was established by Parker et al. in 1961. LFA has been well-known for characterizing the thermophysical properties such as the thermal diffusivity of solid materials. During such a test, the front side of a plan-parallel sample disk is heated by a short laser or light flash pulse. The resulting temperature rise on the rear side of the sample is measured versus time using an infrared detector.

Over the time the characterization of liquids, pastes and solid-liquid transitions was becoming more and more important. The thermal conductivity of a heat transfer paste is, for example, one of the crucial parameters for the later application of the material. A special sample container system for the measurements of liquids, pastes and molten sample was developed.

This work will present some technical details of the container and measurement results for various materials including phase change materials PCMs (see figure 1).

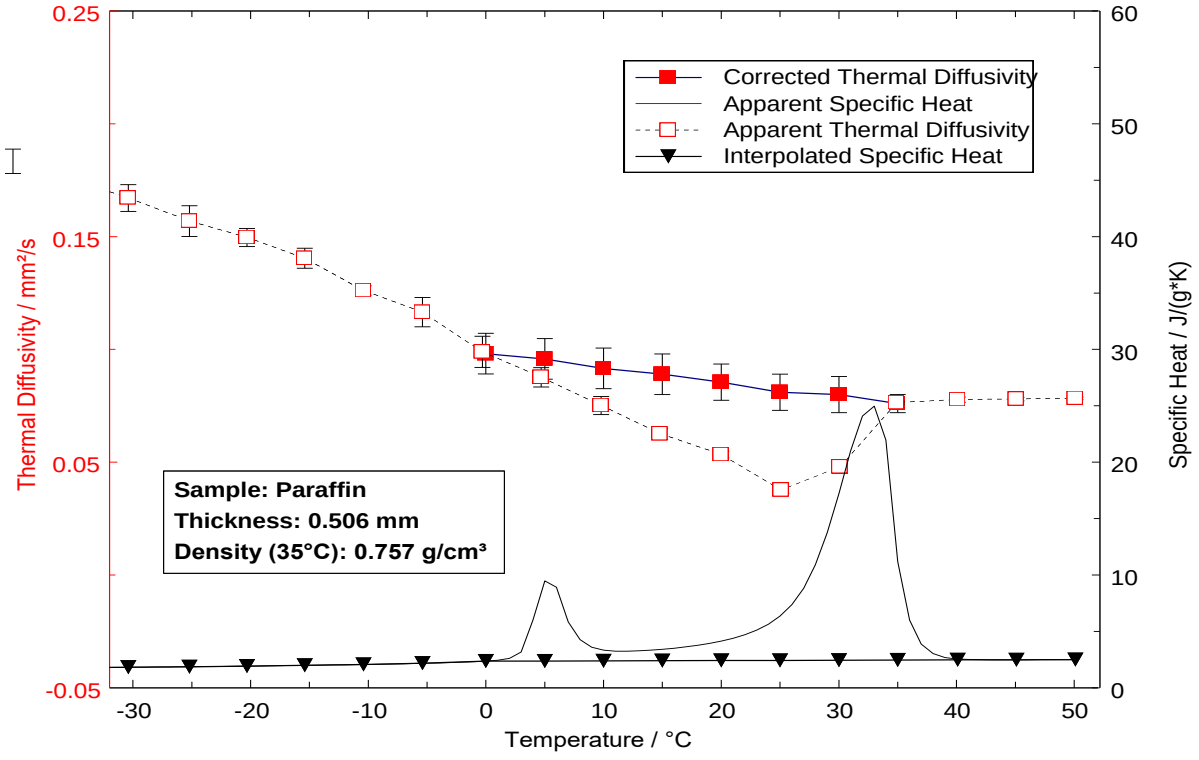

Figure 1: Thermal Diffusivity and Specific heat for a paraffin sample

STORING THERMAL ENERGY IN SMALL PACKAGES: ADDITIVE PROPERTY OF PHASE CHANGE ENERGY STORAGE IN ZINC OXIDE MICRO-ENCAPSULATED SODIUM NITRATE

Ciprian Neagoe[1], Ioan Albert Tudor[1], Cristina Florentina Ciobota[1], Cristian Bogdanescu[1], Paul Stanciu[1], Maria Magdalena Stoiciu[1], Radu Robert Piticescu[1], Maria Dolores Romero-Sanchez [1,2]

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Sodium and potassium nitrates are phase change materials commonly used for thermal energy storage in the 300°C – 400 °C temperatures interval. We previously reported the development and characterization of novel phase change materials obtained by microencapsulation of sodium or potassium nitrate in zinc oxide shells. An example of using $NaNO_3$-ZnO microparticles (mass ratio 4:1) to store thermal energy in a pilot storage tank indicate how to scale up laboratory determinations on thermal properties to build effective capacities for high temperature thermal energy storage.

Microparticles were used to fill a cylindrical ~15 l volume stainless steel storage tank, thermally insulated from the environment and heated at the inside with an axial heat-exchanger implemented as a helical tube circulating heated oil. The temperatures were monitored by thermocouples placed: a) inside the tank, b) on the stainless-steel tank shell, c) on the outer side of the tank-insulation shell and d) in the room. All experiments were performed at atmospheric pressure, monitoring the relative humidity. The energy storage material was heated to temperatures higher than the 307°C $NaNO_3$ melting temperature. Then, the heating was stopped and the tank was left to freely cool down at ambient temperature (free-cooling experiments). A reference energy loss rate for the tank was determined in heating – free cooling experiments using water as energy storage material in the tank. To determine the latent heats and the specific heats, differential scanning calorimetry (DSC) was performed on small samples (micrograms) of microencapsulated material and pure $NaNO_3$.

From the temperatures recorded in free-cooling experiments we were able to identify that the tank-specific maximal time for thermal energy storage in solid-liquid transition was less than 11 hours for ~ 22 kg of microparticles. At temperatures between 285 – 310 °C, the thermal energy stored in the tank by the microencapsulated material largely corresponds to its content of sodium nitrate undergoing solidification. Summing up the latent heats of microgram amounts of $NaNO_3$-ZnO microparticles, as determined by DSC, correlated well with experimental determinations in tank free-cooling experiments. We conclude that micro-encapsulation of sodium nitrate in zinc oxide shells does not alter the phase-change thermal energy storage capacity of the salt. As microencapsulation diminishes the thermal conductivity of the material in comparison with sodium nitrate, the design of a thermal energy storage tank using NaNO3-ZnO microparticles may take advantage of these properties to extend the energy storage time, in conjunction with requirements to pump-extract heat at specific rates.

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INFLUENCE OF DOPANTS ON THE THERMAL PROPERTIES OF NANOSTRUCTURED COMPLEX OXIDES FOR GREEN ENERGY APPLICATIONS

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Development of new phase change materials (PCM) for applications in seasonal storage of thermal energy in the range of medium temperature. Increasement of the thermal energy storage capacity by using PCMs based on sugar alcohols and approaching some methods that allow a controlled increasing of the exchange surface together with controlling the crystallization process during undercooling. Elaborating a simple process for hydrothermal impregnation which assures the functionalization of carbon foams with nanostructured ZnO with flowerlike morphology to avoid the crystallization of the sugar alcohols selected as PCMs (Mannitol, Erythritol, Xylitol) during the thermal cycles. The carbon materials impregnated with ZnO particles are used to control the surface properties at the substrate/PCM interface.

Sugar alcohols are relatively new materials thus there is little general information available about them. Their melting temperature is in the range 90-200°C, and their mass specific fusion enthalpy is relatively high for most of them. In addition, their density is also high, which also means very high-volume specific fusion enthalpies. Compared with some other organic materials, sugar alcohols have stable subcooling. They are not harmful for the environment.

These PCM are obtained by the hydrothermal synthesis and in-situ attachment of ZnO colloidal nanoparticles within the porous carbon structures.

The mechanism is based on the results provided by the XRD, FT-IR, SEM, EDAX, potential zeta assays and involves the following may stages: the zinc hydrocarbonate nucleation governed by the homogeneous precipitation reaction of Zn^{2+} with the urea, its attachment to the functional groups on the surface of the carbon structure and the thermal decomposition of this compound to ZnO with a flower-like structure, at temperatures higher than 200°C. Due to the high degree of novelty, there is a lack of standardized methods to investigate the hydrophobic behaviour and thermal transfer properties of the proposed C/ZnO/sugar alcohols systems.

Acknowledgments: FP7 296006 „Sugar Alcohol based Materials for Seasonal Storage Applications" – SAM.SSA

SECTION 2. ADDITIVE MANUFACTURING

PROTOTYPE ORTHOPAEDIC PROSTHESES 3D PRINTED BY LASER MELTING DEPOSITION (LMD)

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Ti6Al4V cranial prostheses in form of meshes were 3D printed by Laser Melting Deposition in argon environment, using an Yb:YAG disk laser source and micronic Ti6Al4V powder as starting material. The printing was conducted using a robotic arm with computer-controlled movements. The printed material was investigated by optical microscopy and was found to be dense, without porosity. Metallographic investigations exposed the biphasic α+β structure, with α grains developing dendritically in a β matrix. Energy dispersive X-ray spectroscopy revealed a composition very similar to the starting powder material. Mapping of selected areas on surface showed a uniform distribution of elements, with no segregations or areas with poor elemental distribution. X-ray diffraction evidenced two crystalline phases entering in composition of the bulk printed structure: a hexagonal phase similar to Ti and a Ti(1-x)Vx with cubic structure.

In order to reach the desired resolution for prostheses, a fine tuning of the laser power and the powder debit was conducted, in order to obtain a solid shape even after a single laser pass and to diminish unwanted blown powder stuck in the vicinity of the prosthesis elements. The robot trajectories selected for tracing the programmed contour proved to have an important influence on the quality of the printed shape and therefore a discussion with relevant examples will be conducted.

In vitro tests consisting in viability and proliferation of steoblast-like cells conducted on both printed and casted Ti6Al4V samples showed very similar biological behaviors, certifying that the deposited material is bioinert after deposition.

Acknowledgements

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CHARACTERIZATION OF IN 625 RECYCLED METAL POWDER USED FOR SELECTIVE LASER MELTING

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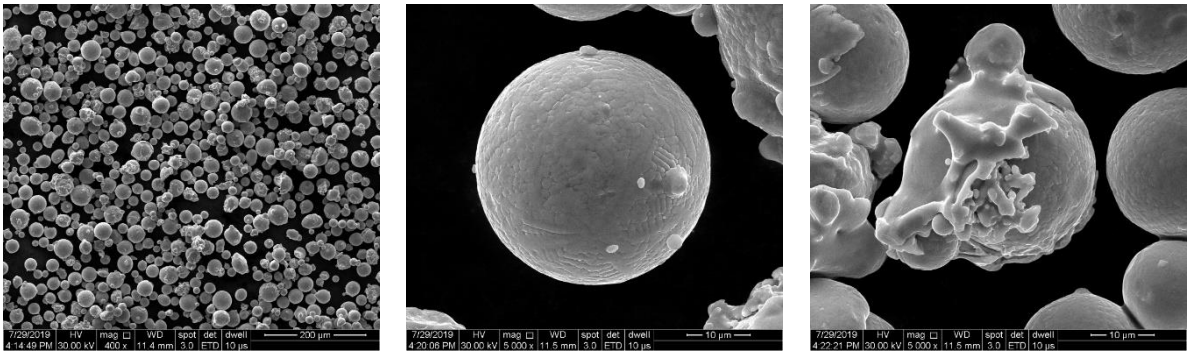
Additive manufacturing of high-quality materials by Selective Laser Melting (SLM) depends not only on establishing appropriate process parameters, but also on the characteristics of the metal powders used and their stability over time or after recycling. The aim of the research was to characterize the IN 625 powder used with a Lasertec 30 SLM machine. This machine has embedded a powder recycling system which involves the powder recirculation over multiple manufacturing cycles. In order to achieve the research's goal, virgin and recycled powders were extracted from a new powder container and from the machine tank. Powder physical and technological characteristics were investigated (particle size distribution, morphology and surface quality, apparent and tapped density, flowability).

A decrease in all D-values (D_{10}, D_{50}, D_{90}) of the powder size distribution was observed after multiple recirculation cycles showing a decrease of the powder dimensional range which can have a negative effect on the flow capacity of the powder over time. Both virgin and recycled powders are composed of mainly spherical particles under 45 μm, but elongated particles and satellite particles were observed, as shown in Fig. 1 for virgin powder. The dimensional evolution analysis showed a deviation from the powder ideal circularity, deviation that is more pronounced over multiple recirculation stages. It was experimentally determined that the powders present a good flowability based on the flow rate value obtained for both virgin and recycled powders (values in compliance with the powder technical data sheet), confirmed also by the Hausner ratio and angle of repose.



a) b) c)

Fig. 1. SEM images: (a) - general aspect; (b) - spherical particles; (c) – particles with satellites

Acknowledgements

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INNOVATIVE 3D PRINTING TECHNOLOGIES FOR HYBRID NANOSTRUCTURED MATERIALS PROCESSING

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The adoption of new methods such as the development of 3D printing techniques for the manufacture of ceramic materials is a new concept that has appeared relatively recently. Three-dimensional printing has significant potential as a fabrication method for a wide range of structures with different applications such as medical devices, aerospace, electronics, automotive, construction, etc. The advantages of fabricating scaffolds using 3D printing are numerous, including the ability to create complex geometries and porosities, the ability to print small quantities of customised products with relatively low cost.

3D printing extrusion technology of paste-like materials, which are passed through a nozzle to form fibers disposed as 3D structures of various shapes, allows the manufacture of scaffold materials with complex internal structures and high resolution, designed according to the needs of each application.

The aim of this work is to demonstrate the potential of extrusion-based 3D printing to fabricate different porous structures based on ceramic and/or hybrid materials with potential applications in bone tissue reconstruction (as implant) or waste water treatment (as membranes for metallic ion retention).

A few examples are given, such as fabrication of three-dimensional structures based on hydroxyapatite (HAp) from natural sources [1] and HAp-based hybrids [2] for bone reconstruction, barium titanate-collagen for bone implants, or carbon nanotubes-ZnO for environmental applications.

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EDGE AND CORNER EFFECTS IN SELECTIVE LASER MELTING OF IN 625 ALLOY

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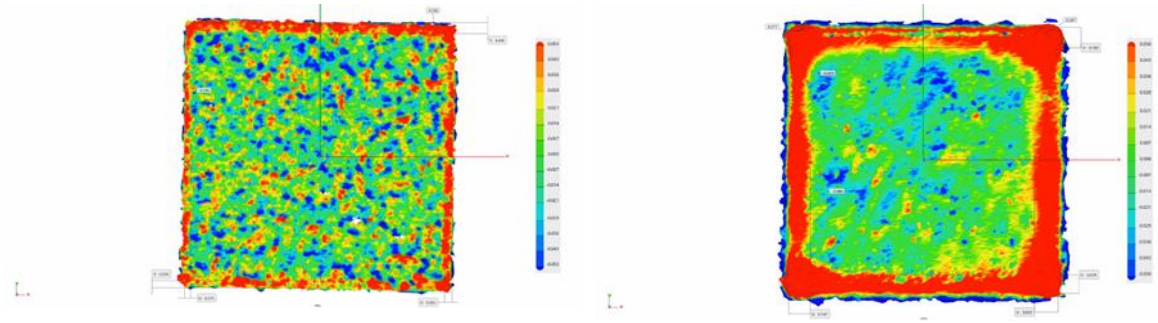
Experimental investigations of top surface of 10 x 10 x 20 mm^3 specimens were carried out in order to assess the influence of laser power and scanning speed on edge and corner effects occurrence in Selective Laser Melting (SLM) of IN 625 alloy. Since the melt-pool behaviour is strongly influenced by the process parameters, specimens manufactured with no contour using the same layer thickness (50 µm), hatch distance (0.1 mm) and 67° rotated scanning strategy for different levels of laser powers and scanning speeds were investigated by 3D laser surface scanning to analyse the change of surface profiles. The surface profiles were investigated in parallel direction with the specimen sides to investigate the rising of the edges and on the diagonal of specimen surfaces to investigate the corners.

The experimental results have revealed that melt-pool behaviour during solidification generates elevated ridges on both specimen sides and corners that are strongly influenced by the energy input done by laser power and scanning speed. With the increase of laser power from 150 W to 400 W, at a constant scanning speed, both edge and corner ridges increase, the rising of corners being much more pronounced. On the contrary, at constant laser power and variable scanning speeds between 500 mm/s to 1000 mm/s the edge and corner ridges decrease, less obvious in the case of the edges. It was also highlighted that the edge ridges width follows the same trend. The edge ridges width increases with increasing the laser power and decrease with increasing the scanning speed. A quantitative evaluation of this behaviour was performed. Fig. 1 presents the surface profiles of two specimens manufactured with different process parameters.



a) b)

Fig. 1. Top surface profiles comparison of specimens built with 150 W laser power (a) and with 400 W laser power (b) using the same 900 mm/s scanning speed

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PROTOTYPE CRANIAL MESH PROSTHESES FABRICATED BY SELECTIVE LASER MELTING (SLM)

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Ti6Al4V cranial prostheses in form of patterned meshes were laser 3D printed by Selective Laser Melting in argon environment, using a CO2 laser source and micronic Ti6Al4V powder as starting material. The size and shape of prostheses were chosen based on actual computer tomography images of patient skull fractures supplied in the framework of a collaboration with a neurosurgery clinic. After optimizations of scanning speed and laser parameters, the printed material was defects free as shown by metallographic analyses and chemically it was uniform, without elemental segregation or depletion, as revealed by electron diffraction X-ray spectroscopy. The bulk had an α+β martensitic metallographic structure with randomly oriented acicular grains. The prostheses produced by 3D printing were further coated by Magnetron Sputtering with a bioactive thin layer of a natural animal origin hydroxyapatite, obtained from calcination of bovine bones. The X ray diffraction structural investigations of films revealed a monophasic hexagonal hydroxyapatite phase. Degradation tests demonstrated the biomineralization capacity of the films and resistance to degradation in biomimetic environments. In vitro tests were conducted in order to test the natural apatite bioactivity. Osteoblast cells proliferated from 1-7 days, they extended over the substrate in order to maximize surface contact and emitted pseudopodes, to the difference of cells grown on borosilicate control glass that kept a polyhedral shape.

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COMPARISON OF CHEMICAL AND ELECTROCHEMICAL POLISHING AS A SURFACE FINISHING METHOD OF AM BUILT 316 STAINLESS STEEL

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Additive Manufacturing (AM) is a rapid growing branch of industry offering several advantages over traditional manufacturing methods.[1] However, one of the drawbacks is rough surface of the built object, that often require manual work to finish resulting in higher cost of the manufacturing process. [2]

This study is a comparation of chemical and electrochemical methods for surface finishing of AM built 316 Stainless Steel, process that could replace manual work and result in lower overall cost of AM fabrication. Influence of key parameters – temperature and time has been investigated for both chemical and electrochemical polishing, and the current density for the latter process.

Our study has clearly demonstrated that both chemical and electrochemical processes can remove partially fused particles resulting in much improved surface, it is worth noting that electropolishing was leaving very smooth surface, as observed using SEM and reduce roughness of the surface significantly as witnessed with White Light Scanning. Differences in surface morphology between the samples are presented in the Figure 1.

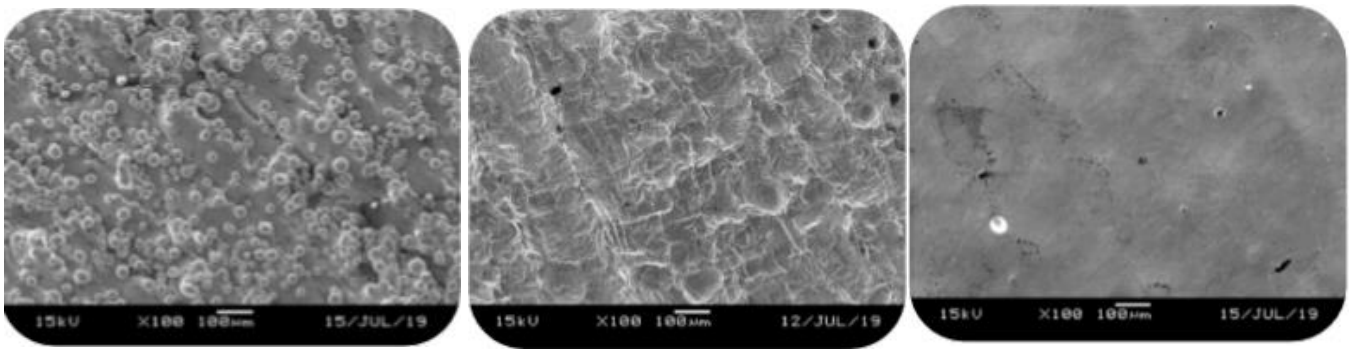

Figure 1. SEM micrograph of surface of AM built 316 Stainless steel, as built (left), chemically polished (middle) and electrochemically polished (right).

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TRIBOLOGICAL STUDY OF INJECTION MOLDED ZTA FOR ORTHOPEDIC IMPLANTS

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Introduction: there is an increasing demand for joint replacements with enhanced mechanical strength, durability, biocompatibility and tribological performances. Wear is one of the most important factors limiting the longevity of an endoprosthetic joint. The wear debris released in the human body may trigger osteolysis and aseptic loosening, pain, reduced mobility, and consequently induce revision surgeries. Ceramic-on-Ceramic (CoC) bearings exhibit a superior wear performance compared to Metal-on-Metal (MoM), Metal-on-Polymer (MoP) or Ceramic-on-Polymer (CoP) [1]. The present tribological investigation deals with the wear and friction of zirconia toughened alumina. The wear and friction coefficient of the ceramic-on-ceramic interfaces at different loads and lubrication conditions (dry and bovine calf serum) were carefully evaluated.

Aim: this investigation explores the tribological properties of zirconia toughened alumina (ZTA) produced by ceramic injection molding (CIM). The study aims to compare dry and lubricated wear under variable load conditions to help determine the reliability of the materials under mild and severe working conditions.

Experimental: ZTA flat samples and cylindrical pins were CIM manufactured by Salentec S.R.L. starting from a proprietary feedstock with the inorganic fraction composed by a mixture of 83%vol alumina and 17%vol zirconia powders. The tribological tests were performed with a tribometer (NANOVEA T500), according to ISO standards [2] and previous investigation[3] using the “pin on disk” configuration. The tests were carried out for 120 minutes 100 mm/s with different loads (10, 20, 40 N) in dry and lubricated conditions with bovine calf serum (BCF, total protein range 5.8 - 7.1 g/dL). The average wear rate kw was calculated as the ratio of the volume loss Vw by the length of travel s along the track and the applied force F [4]. Scanning electron microscopy and surface roughness by Dektak XT stylus profiler (Bruker) were undertaken to characterize wear.

Results and discussion: a low friction coefficient is desirable for endoprosthetic joints; in dry conditions a stable friction coefficient of 0.34 was measured for a Hertzian pressure of 1579 MPa (load 10N); this value is lower than the obtained coefficients for the same load conditions in wear studies on ZTA femoral head by *Puppulin et al.* [5] (0.52) and by *Marin et al.* [3] (0.53), and also in the tribological tests on ZTA by *Kerkwijk et al.* [4] (0.43). The friction coefficient decreases linearly with increased load (40N) up to 0.11, probably due to a greater flattening of the roughness at the bottom of the track. SEM analysis shows a clear wear in dry conditions, with an increased track thickness of 31% from 10N to 20N and 77% at 40N. The tribological performances of CIM ZTA confirm that lubrication conditions play an important role in Ceramic-on-Ceramic bearings, minimizing friction and wear [6]. In wet conditions, friction coefficient (0.08) remain constant in each test and the wear track shows a slight increase in thickness only at 40 N.

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SECTION 3. CRITICAL MATERIALS

PROCESSING OF HIGH-GRADE ZEOLITE COMPOSITES FROM SOLID FUEL COMBUSTION BY-PRODUCTS AS CRYTICAL RAW MATERIALS SUBSTITUTES

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Zeolites are microporous aluminosilicate materials of natural or synthetic origin of extreme practical importance as adsorbents, dryers, molecular sieves, ion-exchangers, catalytic carriers, etc. However, the potential of these materials is not fully exploited beyond their traditional applications. By managing their morphology to nanoscales or modifying them with additives and fillers, they become valuable materials for sensing devices, photocatalysts, solar thermal collectors, photovoltaic energy conversion systems, optoelectronics, smart coatings, preparation of functional host-guest materials [1]. Due to their thermal stability, resistance to chemicals, radiation and oxidation, lack of corrosion and the absence of disposal problems because of their harmlessness and environmental compatibility, zeolites are preferable materials to replace successfully many CRM-containing coatings, catalysts and energy materials.

High-grade zeolite nanocomposites are synthesized utilizing solid by-products from combustion of coal at energy production in Thermal Power Plants by alkaline hydrothermal and fusion-hydrothermal activation [2]. The obtained coal ash zeolites were studied with respect to their chemical and phase composition, morphology, surface parameters and thermal properties. It was found that they are distinguished in significant content of iron oxide nanoparticles (γ-Fe_2O_3, α-Fe_2O_3, γ-Fe_3O_4) and doping elements (Cu, Co, Mn, V, W, etc.) transferred from the raw coal ash, a mixed micro-mesoporous texture, nanocrystalline morphology, significant concentration of acidic Brønsted centers, high structural and thermal stabilty, etc. This unique combination of compositional and textural properties predetermines the application of these materials as catalysts for thermal oxidation processes, anticorrosion barrier coatings, carbon capture adsorbents, carbon dioxide to fuel catalytic conversion media, matrixes for hosting functional groups, etc. The examples for coal ash zeolite applications will be provided.

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INTERNATIONAL COOPERATION IN CHEMICAL CHARACTERISATION OF NONFERROUS AND FERROUS ALLOYS

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MBH is a UK based company that provides Certified Reference Materials (MRCs, standards) for chemical concentrations determination of elements in a wide range of products. During last 3 years IMNR and MBK collaborated by analyzing ferrous and non-ferrous alloys, together with other analytical laboratories around the world, in order to establish the chemical composition of these MRCs that are subsequently sold. IMNR analysis laboratory is involved in this international interlaboratory comparisons (Z score).

Several analytical techniques participated in this collaboration from our laboratory: ICP-OES, FAAS, gravimetry, volumetry. The number of samples by type of alloy with basic element are: Fe 78, Cu 60, Pb 34, Zn 17, Al 13, Ni 7, Sn 6, Co 1, in total 216 MRCs from which determined 4398 elements (on average 20 elements/sample).

The samples received are in the form of chippings (~ 25g). For each sample, several disaggregation (solubilizations) were performed, the methods used being "wet". The concentration range according to the elements required for the analysis is from 0.0001% to tens of percent. The requested elements were: Ag, Al, As, Au, B, Be, Bi, Ba, Ca, Cd, Co, Cr, Cu, Fe, Ga, Ge, Hg, In, Mg, Mn, Mo, Nb, Ni , P, Pb, S, Sb, Sc, Se, Si, Sn, Ta, Te, Tl, Ti, V, W, Zn, Zr, matrix function. In the vast majority all the requested elements were analysed, except C and N where these elements were requested, based on Fe in particular. The contribution of the techniques to the analysis was ICP-OES 74%, FAAS 24%, chemically 2%.

The equipment used were ICP-OES spectrometer from Agilent Technologies, model 725 Radial Simultan with spectral range 167 - 785nm, and for FAAS spectrometer ZEEnit 700 from Analytik Jena

In the ICP-OES technique to determine the low concentrations for various elements, several spectral lines of the same element were chosen, and by the spectra visualization, the spectral lines without interference were selected.

Among the countries participating in these analyses we list: England, USA, Canada, Australia, China, India, South Africa, Italy, Czech Republic, Poland ... After sending the results by the participating laboratories, they are processed statistically and a Certificate of Analysis is obtained. It contains a consensus value and the associated uncertainty. Using this data, each laboratory can calculate its Z-score for self-assessment.

The standards thus obtained (216) are a valuable dowry for the laboratory being used after pastillation and in the techniques: LA-ICP-OES, DRX, Optical Microscopy, SEM, as MRCs.

Acknowledgment: The study was conducted using the infrastructure obtained with the Structural Funds Project - High PT Met Ctr.253 / 2010 and through the Core Project PN 1919 financed by Ministry of Research and Innovation

CORRELATION BETWEEN SUBSTRATE ION FLUXES AND PROPERTIES OF HIPIMS-DLC FILMS USED IN INTERNAL COMBUSTION ENGINES

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Future components for internal combustion engines (ICE) will require coatings with increased temperature stability (up to 500 °C) and wear resistance as compared to present day solutions (like CrN). Hard DLC films are a good alternative for that. Besides their extremely smooth surfaces and their very low coefficient of friction, these coatings also performed very well under mixed and boundary lubrication and, thus, are very attractive for automotive industry [1]. High Power Impulse Magnetron Sputtering (HiPIMS) has been under consideration for hard DLC films deposition in recent years. The major driver to use HiPIMS for DLC deposition is the possibility of C ions formation in the plasma and subsequent use of these ions to bombard the substrate.

The main strategy to achieve ionization of the sputtered species in HiPIMS is to promote electron impact ionization trough increasing the plasma density. This route has been successfully implemented for many metals, i. e, for elements which exhibit ionization energies between 6 and 8eV. However, this strategy is not effective for C which exhibit a significantly higher ionization energy (11.6eV) and lower ionization cross-section. As a result, in HiPIMS discharges with a C target the C^+/C ratio does not exceed 5% [2].

In recent years, several strategies have been investigated in order to overcome this problem. One strategy to increase the ionization reaction of the sputtered carbon species, proposed by Aijaz et al., consists in increasing the electron temperature of the discharge [2]. This can be achieved by using gases with higher ionization energy than Ar (15.6eV) such as Ne (21.56eV) in the plasma. In this work, this strategy is used to deposit DLC films. The carbon ions fluxes/energies produced during the process were investigated using a flat probe and correlated to the structural and mechanical/tribological properties of produced DLC films.

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A COMPARATIVE STUDY OF THE MECHANICAL PROPERTIES OF Al2O3 COATINGS FABRICATED BY ATOMIC LAYER DEPOSITION AND RADIO FREQUENCY SPUTTERING

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Al_2O_3 protective coatings deposited by Atomic Layer Deposition (ALD) have attracted considerable attention in the past years. With respect to many other deposition techniques, ALD has the ability to coat conformal coatings on complex geometries and, due to the low porosity, Al_2O_3 films grown by ALD have been recently proposed as protective coatings against corrosion in several applications.

For this reason, ALD alumina coatings may provide alternative to Cr-based coatings and/or coatings containing critical raw materials such as for examples chromate conversion coatings (CCC), NiCrAlY coatings, WC-CrNi, Cr_3C_2–NiCr, WC-CoCr, etc.

In this work we compare the structural, morphological and mechanical characteristics of 80 nm thick Al_2O_3 coatings fabricated by ALD and radio frequency sputtering. ALD coatings were deposited on flat glass and Si substrates at 150°C starting from tri-methylaluminum (TMA) precursors. Coatings deposited on Si substrates were submitted to annealing in air (from 500 °C to 900 °C) inside a tubular furnace.

Radio frequency sputtered Al_2O_3 films where grown at room temperature on same substrates at a radio frequency power of 300 W and different oxygen partial pressures. Also these samples were submitted to annealing in air at same temperature as ALD coatings.

X-ray diffraction and nano-hardness measurements were used to infer the structural and mechanical properties of the as deposited and annealed ALD and sputtered films.

METAL FIBER BRUSHES AS A SUBSTITUTE OF GRAPHITE AND AN INNOVATIVE APPLICATION

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Although graphite and metal-graphite brushes have for nearly 100 years dominated the field of electrical brushes, for many applications there now exists a superior form of sliding electrical conduction; high performance fiber brushes wherein typically the fibers are made of metal for which reason they are called metal fiber brushes. Prime candidates for this new technology include sliding electrical systems which require high current densities, high sliding speeds, low electrical noise, high efficiency (low brush losses), compact size, or long brush lifetimes.

In particular, low voltage electric motors and generators can be made smaller, more powerful and longer lasting owing to the increased current capacity, higher efficiency and longer wear life. This has a direct bearing on electric vehicular and ship drive systems as well as low voltage electrical power generators. Other applications which require high currents, such as high-force linear actuators, electromagnetic brakes, and armatures, are similarly well suited. As an application we will show a "**slip ring**" to transmit electric current from the car frame to the interior of a tire to refrigerate or heat it and thus optimize its performance.

INTERMETALLICS AS CRM SUBSTITUTES IN AUTOMOTIVE AND AEROSPACE INDUSTRY

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Intermetallic compounds are very interesting materials, having the properties between metals and ceramics. Due to this fact they enable e.g. utilization at high temperatures or in severe corrosion environments. Many intermetallic compounds also have other interesting properties, such as shape memory or ability to store hydrogen reversibly. Due to these properties, intermetallics are interesting materials for application in automotive or aerospace industry. Most of the industrially important intermetallics (aluminides, silicides and Ni-Ti alloys) are CRM (critical raw materials) –free or low–CRM. This paper summarizes current applications of intermetallics, possible future trends in this industrial branch and new solutions developed by the authors. The possible applications of intermetallics are as bulk materials e.g. for exhaust valves or turbocharger wheels for car combustion engines or turbine blades for airplane jet engines or as the surface layers obtained by thermochemical treatment or coating processes. The advantages and problems of the new approaches are discussed individually.

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POROUS CERAMIC MATERIAL WITH HIGH MECHANICAL STRENGTH MADE FROM CLAY WASTE AND COAL ASH USING THE MICROWAVE ENERGY

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The paper presents the results of the experimental research for the manufacture of a high mechanical strength porous ceramic material using the microwave energy. The influence of clay on the increase of mechanical strength is revealed in some works in the literature [1-3]. Clay waste from demolition and rehabilitation of buildings (between 75-83 wt.%) and coal ash (between 15-23 wt.%) as raw material and silicon carbide (2%) as a foaming agent have been used in the form of a homogenized powder mixture. The sintering / foaming process took place in a 0.8 kW microwave oven, the process temperature being over 1100 ºC. The foamed product has a relatively low density and thermal conductivity (between 0.50-0.68 g / cm^3 and 0.069-0.087 W/ m · K, respectively) and high compression strength (between 3.8-7.5 MPa). The pores distribution in the four samples section is uniform and their size is less than 5 mm (Fig. 1). Due to the physical, mechanical and morphological characteristics, the glass-ceramic foam experimentally made is usable in construction as an insulating material for applications involving mechanical stress resistance.

Sample 1 Sample 2 Sample 3 Sample 4

Fig. 1. Section images of the porous ceramic samples

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EFFECT OF CERAMIC BASED COATINGS DEPOSITED ON LOW ALLOYED STEEL 10H2M EXPOSED AT HIGH TEMPERATURE IN AIR OXIDATION CONDITIONS

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Energy consumption increases yearly due to high demand of electricity worldwide, therefore new systems for high temperature protection of structural steels employed in energy sector must be developed. There is different type of coatings used in energy sector; the most popular are thermally spayed coatings by HVOF, APS and others. However, those systems show some degree of porosity, where ash can accumulate and initiate accelerated degradation process of boiler tubes. In order to overcome the problem, there is an idea to develop new systems for high temperature protection of boiler steels based on ceramic compounds [1, 2].

In this research a new type of ceramic coatings based SiO_2- Na_2O- B_2O_3- TiO_2 oxide phases were applied on low alloyed Cr-Mo alloy steel (T/P22, 10H2M). The materials were tested at high temperature in simple air oxidation conditions in order to perform screening test for further tests that will be carried out in aggressive atmosphere (mixed 1%H_2S – Ar or 1%H_2S – Air (Vol. %). The test was carried out at 540°C for 1000 hours. Kinetic data was recorded periodically every 250 hours, macro and micro analyses as well as chemical composition were carried out to observe degradation process of the coatings applied on the surface of the low alloyed steel 10H2M. The micro analyses were performed using Scanning Electron Microscopy (SEM) coupled with Energy Dispersive X-ray Spectroscopy.

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GOLD-CONJUGATED POLYMER NANOCOMPOSITES FOR BIOMEDICAL APPLICATIONS

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Precious and Critical Raw Materials (CRMs) as waste in electrical and electronic equipment / per annum is increasing which are widely used in different products. Huge quantities are disposed each year ~ 30% is collected and recycled in EU. Electric-LCD-electronic and industrial applications ~ 9.9 mtonnes Waste/pa CRMs contained in components with high-performance requirements, are critical for the functioning of the product. Challenge is that these materials (i.e, Gold) are used in very small amounts in metal-complex structures [1,2].

Gold/Polyanthranilic acid (Au/PANA) core/shell nanocomposites with uniform size and morphology have been recently synthesized and characterized[2,3]. Au/PANA nanoparticles were electrospun following to blending with PVAc. Albumin (Alb) or Streptavidin (STV) were covalently immobilized onto (Au/PANA/PVAc) nanofibers by EDC/NHS activation using (-COOH) groups amine groups on the proteins of modified gold particles.

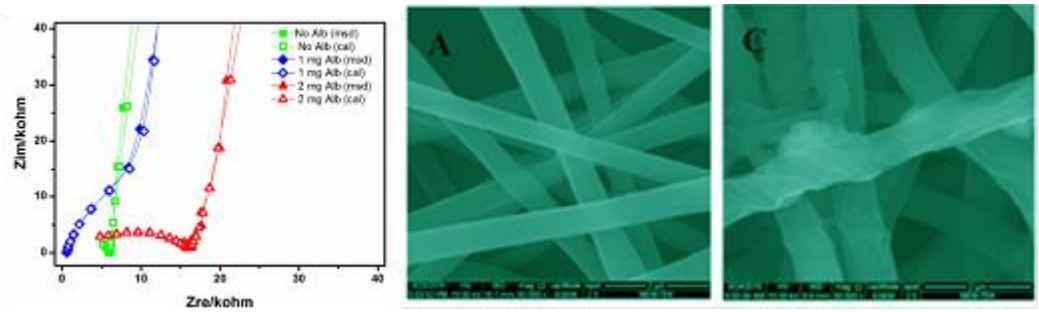

Fig. 1.EIS and SEM images of B) (Au/PANA/PVAc)(1/3) nanofibers before albumin immobilization C) after immobilization of 2 mg/ml albumin[2]

Effects of immobilized enzyme on Gold nanocomposites as nanofibers were investigated by Electrochemical Impedance Spectroscopy (EIS) and the data were fitted to equivalent electrical circuit model. SEM, Elemental analyses and EDX-mapping showed that the enzyme was evenly distributed. The solution resistance and charge transfer resistance of nanofibers decreased after enzyme immobilization. The electrochemical properties of nanofibers significantly changed after protein immobilization depending on the changes in morphology and surface charge of nanofiber mats. The nanofibers become resistive due to protein immobilization and the higher charge transfer resistance was observed after higher amount of protein was immobilized [2-4].

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REUSE OF Fe-BASED AMORPHOUS ALLOYS CONTAINING CRM FOR WASTEWATER REMEDIATION

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Physicochemical properties of four Fe–based amorphous alloys containing critical raw materials (CRM) were investigated together with the possibility to reuse them for photocatalytic degradation of Methyl orange (MO) azo dye. The iron-based metallic glasses were prepared by melt spinning method. Their chemical composition is: $Fe_{81}B_{13.5}Si_{3.5}C_2$, $Fe_{78}B_{15}Mo_2Si_5$, $Fe_{67}B_{14}Co_{18}Si$, and $Fe_{40}B_{16}Ni_{40}Mo_4$. Characterization of the ribbons was done using combination of analytical methods. The phase composition and crystallinity were studied using powder X-ray diffraction (XRD), RT and LNT Mössbauer spectroscopy (MS). Crystallization processes of investigated Fe–based amorphous alloys depending on their chemical composition were observed using thermal analysis and *in situ* high temperature X-ray diffraction analysis up to 1000 °C in inert atmosphere. Catalytic properties of studied series of samples were registered in photo-Fenton reaction of dye degradation. The catalytic tests were performed using Methyl orange as a model dye-contamination.

It was registered that the homogeneous amorphous structure of studied iron-based metallic glasses is beneficial to MO dye adsorption and degradation. $Fe_{81}B_{13.5}Si_{3.5}C_2$ glassy ribbons showed the best reductive efficiency in Methyl orange degradation, together with $Fe_{67}B_{14}Co_{18}Si$ and followed by $Fe_{78}B_{15}Mo_2Si_5$ and $Fe_{40}B_{16}Ni_{40}Mo_4$. Comparative analysis of the bulk and the surface of initial and spent samples (after photocatalytic tests) were done by MS, XRD, CEMS and XPS methods. Based on this characterization, it was concluded that the zero valent iron plays a key role in degradation process because it contributes to the formation of an incompact Fe or Fe-Co oxide layer at the metal–water interface. It has been found that the presence of the additional elements as Mo or Ni in the ribbons decrease photo-catalytic activity of the alloy. This could be regarded to lower surface reactivity due to a passivation effect of these elements and localization of the initial fast electron transfer in those ribbons. This study details the insights into sustainable reuse of Fe–based amorphous materials for dye-contaminated wastewaters remediation.
Ioana Vlaicu (ioana.vlaicu@imnr.ro) by September 20th, 2019.
The abstract should not be longer than one A4 page.

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SECTION 4. ADVANCED MATERIALS FOR EXTREME CONDITIONS

GRAPHENE AND OXIDE GRAPHENE COMPOSITE WITH PHOSPHATE GLASS

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The developing graphene-based composites which implies a significant improvement in the mechanical properties of the host matrix are also accompanied by modification of functional properties such as electrical conductivity, thermal conductivity and barrier behaviour [1]. Graphene oxide (GO) has one major advantages for processing in that it can be exfoliated in water and so nanocomposites can readily be prepared with the use of water-soluble polymers. The high surface area, hydrophilicity and good biocompatibility of GO are promising properties for biomedical based applications [2].

Nanoplatelets (NP) composites of 45S5 bioglass® and graphene NPs by spark plasma sintering were prepared [3]. In order to make graphene / GO composite with glass G and GO additived glasses were prepared by sol- gel route and by classical melting/quenching method. In this paper we present the GO preparation and the GO/glass composite obtaining. In the case of sol-gel technique a ternary zinc-boron-phosphate glass was prepared with the following composition: 10ZnO $20B_2O_3$ $70P_2O_5$. The GO ethanol solution was prepared according to Marcano-Tour method [4]. From GO suspension with glass precursor sol mixed together were deposited films on borosilicate glass substrates using spin coating. One and three subsequent films were deposited at 1500, 3000 and 4500 rotation/min. Both GO and GO-glass composites were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD), Raman and FTIR Spectroscopy.

Key words:- materials for (bio)medical applications, energy applications, advanced materials

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HIGH THROUGHPUT SCANNING WITH A CALPHAD DATABASE FOR HIGH TEMPERATURE BCC HIGH ENTROPY ALLOYS

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We used Thermo-Calc CALPHAD calculations to determine the stable phases of different bcc high entropy alloys (HEAs) that include refractory elements and Al. The combination of high melting temperatures of refractory elements and oxidation resistance promoted by Al is meant to produce alloys suitable for very high temperature applications. Sorting out alloys that retain a single discorded bcc phase down to relatively low temperature is meant to help find alloys with good mechanical properties. High dimensional grids in composition space were constructed, with stable phases calculated as a function of temperature at each grid point. Scanning through millions of compositions resulted in finding the compositions with the desired properties.

By filtering out these compositions, 'islands' of high entropy alloys in composition space are determined. The sizes and shapes of such islands provide insight into which element combinations have good high entropy alloy forming qualities as well as about the role of individual elements within an alloy. The methodology was applied to several HEA candidates, including AlCrMnNbTiV and TaMoCrTiAl. We determined which compositions lie near the centers of HEA islands in composition space and thus remain HEAs under small composition changes (and have some margin against the inevitable inaccuracy in CALPHAD results).

Two predicted bcc Al (and Cr) containing HEA island center compositions, Al25Cr7Mn25Nb1Ti1V41 and Al21Cr7Mn21Nb1Ti9V41, were experimentally confirmed to consist of single disordered bcc phases. However, the detrimental effect on oxidation resistance from a high concentration of V (which forms volatile oxides) outweighs the positive effect from an enriched Al concentration. AlCrMnNbTiV samples showed poor oxidation resistance. Equi-molar TaMoCrTiAl had earlier been shown to have good oxidation resistance and Ta5Mo24Cr22Ti22Al27 is expected to have better oxidation resistance still.

DEVELOPMENT OF A NON-INVASIVE BREATH TEST FOR EARLY DIAGNOSIS OF TROPICAL DISEASES

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The main objective of this study consisted in the development of a fast, inexpensive, and easy-to-operate diagnostics tool for on-site early detection of Echinococcosis, Leishmaniasis and Dengue, based on the analysis of exhaled breath composition by means of an electronic olfaction system. Echinococcosis, Leishmaniasis and Dengue are included in the list of 17 neglected tropical diseases elaborated by the World Health Organization (WHO), which are a group of tropical infections that are prevalent in the tropical and subtropical regions of Africa, Asia and the Americas, affecting especially the low-income populations in the developing areas. All these neglected tropical diseases generally cause unspecific symptoms, and they cannot be easily identified when a patient arrives at the hospital. The failure of an early diagnosis and prescription of an adequate treatment can be extremely negative and even fatal for the patient.

The proposed approach is based on breath samples analyses, which are easy to obtain and present no discomfort or risk for patients' health. In this study, patients with three different types of neglected tropical diseases (Hydatidosis, Leishmaniasis and Dengue) from different geographical locations (Europe, South America and Maghreb) have been enrolled. Breath sampling followed a standardised procedure. Analytical chemistry methods were employed for the identification of the breath volatile biomarkers of these diseases. A pool of potential nanomaterials with high affinity towards the identified volatile biomarkers has been selected (e.g., gold nanoparticles, carbon nanotubes and semiconducting nanowires, either pristine or functionalised with selected hydrophobic organic molecules, bio-molecules and/or metallic nanoparticles). Hydrothermal-electrochemical deposition of functionalized Au NPs and CNTs in a single step process at low temperatures (20-50°C) and high pressure (>100 atm) on a sensing device substrate (working electrode) was developed for the fabrication of sensing device.

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NANOSTRUCTURED TRANSITION METALS OXIDES

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The interest in the unique properties associated with materials having structures on a nanometer scale has been increasing at an exponential rate in last decade. Transition metal oxides are preferred materials for catalytic applications due to their half-filled d orbitals that make them exist in different oxidation states. Transition metal oxides show a broad structural variety due to their ability to form phases of varying metal to oxygen ratios reflecting multiple stable oxidation states of the metal ions. The Solar Physical Vapor Deposition (SPVD) presented in the paper as elaboration method is an original process to prepare nanopowders working under concentrated sunlight in 2kW solar furnaces. The influence of the synthesis parameters on the chemical and microstructural characteristics of zinc and manganese oxides synthesized nanophases has been systematically studied using XRD, TEM and SEM.

Keywords: *characterization, morphologie, transition metals nano-oxides, structural characterization, doping.*

RESEARCH ON MULTICOMPONENT ALLOYS FROM THE FECRNIMN-X SYSTEM FOR EXTREME USE CONDITIONS

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The research aimed to assess the influence of the fifth element on the structure and properties of some alloys in the FeCrNiMn – X system (X = Al, Mo, Nb).

The obtaining was carried out in the electric arc furnace in vacuum conditions, the structural analysis was done by optical microscopy, electronic microscopy (SEM) and X-ray diffraction (XRD), and the physico-mechanical characteristics were determined by tests of hardness and traction.

It has been found that the addition of the fifth element produces major changes both at the level of the structure, especially as regards physico-mechanical properties.

CARBON BASED NANOPARTICLES FOR APPLICATIONS IN THE TRANSPORT SECTOR: AUTOMOTIVE AND AERONAUTICS COMPONENTS

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When working with polymeric composites, epoxy resins are one of the most commonly used polymer matrices. These resins have good stiffness, strength, dimensional stability, and chemical resistance and durability which makes them useful for a great variety of industrial applications, especially in the electronics, automotive, aeronautics or aerospace industries [1].

However, as polymers, epoxy resins are insulating materials. In recent years, nanoparticles, nanotubes or nanofibers have been considered as fillers for epoxy matrices to produce high performance composites with enhanced mechanical properties [2, 3] and additionally, advanced and multifunctional properties, such as electrical conductivity and self-responsiveness capacity, which are interesting for innovative industrial applications [4]. In this study, CNTs and graphite have been incorporated to provide with electrical conductivity and self-heating capacity by Joule effect to an epoxy matrix.

Additionally, both types of fillers, with different morphology, surface area and aspect ratio, have been simultaneously incorporated into the same epoxy matrix. Results have shown that the electrical conductivity is greatly influenced by factors such as the dispersion of nanoparticles into the matrix, the concentration and the electrical resistance of the polymer–nanofiller interface. It has also been demonstrated that a synergetic effect is produced in the electrical conductivity of the epoxy resin when incorporating simultaneously both types of fillers. The self-heating capacity by Joule effect, thermal conductivity and mechanical properties of the differently filled epoxy resin have been evaluated, obtaining that the higher aspect ratio of the CNTs determines the higher electrical conductivity of the epoxy resin compared to the epoxy resin filled with graphite, but it is the 2D-morphology of graphite the parameter producing the higher thermal conductivity of the filled epoxy resin.

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NANO-PARTICLES REINFORCED STEELS FOR EXTREME WORKING CONDITIONS

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Considerable efforts are made in the production of steel and modifying its microstructure in order to improve final properties, especially to increase hardness and strength while maintaining good toughness, fatigue and creep resistance. Part of the demands is due to the needs for more compact design and weight reduction in the automotive industry and part due to environmental concerns related to high temperature applications in thermal power plants. In this respect nanotechnologies offer huge potential in producing nano-engineered materials with superior combination of properties provided by hard and stable nano-sized particles integrated in the tough metal matrix. However, typical production methods for Metal Matrix nano-Composites (MMnCs) are complex, limited to small parts and expensive. On the other hand, the main drawback of more conventional casting methods is the agglomeration and clustering of the nano-particles as well as a poor interface between the nano-particles and the metal matrix.

The aim of this research work was to investigate the potential of using different nano-particle as reinforcement elements in the conventional liquid-metal casting process, which cannot be obtained or at least not easily through precipitation, as well as to study their effect on the microstructure and properties of austenitic stainless steel AISI 316L. The investigation was focused on the influence of nano-particles type and their modification (dispersion agent and surface activation) on the distribution homogeneity within the steel matrix and final properties of the investigated stainless steel. Nano-particles included in the investigation comprised three types of oxide nano-particles (Al_2O_3, Y_2O_3 and TiO_2) and three types of Ti-based nano-particles (TiO_2, TiC and TiB_2) with the nominal size of 50 nm and concentration of 0.5 %. In terms of properties hardness, tensile strength, impact toughness, bending fatigue resistance, high temperature creep resistance and abrasive wear resistance were evaluated.

The results show that also in the case of the conventional casting process, it is possible to produce reinforced stainless steel-matrix nano-composite with a homogeneous distribution and coherent bonding of the nano-particles in the steel matrix. Furthermore, homogeneous distribution of nano-particles resulted in improved hardness, fatigue and wear resistance, while maintaining the yield and ultimate tensile strength of the reference non-modified stainless steel. On the other hand, intensified precipitation of σ phase above 600°C led to reduced high-temperature creep resistance, with the incorporated nano-particles acting as nucleation sites.

Keywords: nano-particles, stainless-steel, metal-matrix nano composite, strength, creep, wear

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MATERIALS FOR ENERGY APPLICATIONS: CHARACTERISATION OF THE AUSTENITIC STEELS AFTER AIR AND STEAM OXIDATION

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The austenitic steels with high Cr content such as Super 304H and HR3C are often use in new constructions where supercritical conditions (USC) are met: steam temperature 565-620 °C, pressure up to 30 MPa. Recently, due to high corrosion and creep resistance the mentioned materials has become one of the most investigated alloys for the construction of new power coaled burning units [1–3]. High temperature corrosion resistance of the exposed materials was carried out using two stages experimental procedure.

Firstly, high temperature tests in air atmosphere was conducted at 650°C for 1000 hours, further air oxidized samples were exposed in steam atmosphere as well at 650°C for 1000 hours together with the unexposed samples. The aim of this work was to establish whether air oxidation process of high Cr steels influence high temperature steam oxidation. The samples in both atmospheres where exposed for 100, 200, 500 and 1000 hours respectively. The microstructure, chemical and phase composition of the austenitic steels (Super 304H and HR3C) after high-temperature air and steam oxidation were performed using Scanning Electron Microscopy (SEM) supported by Energy Dispersive X-ray Spectroscopy (EDS) and finally X-ray Diffraction (XRD).

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DESIGN, OBTAINING AND CHARACTERIZATION OF NEW MATERIALS BASED ON ZIRCONIA DOPED WITH MIXED RARE EARTH OXIDES

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Monazite is one of the most valuable natural resources of rare earth oxides (REOs) used as dopants with high added value in ceramic materials for extreme environments applications. The complexity of the separation process in individual REOs due to their similar electronic configuration and physical-chemical properties is reflected in products with high price and high environmental footprint.

During recent years it was demonstrated that co-doping of zirconia ceramics with REOs may avoid grain size coarsening due to interface segregation enhancing its ionic conductivity properties and improve sin terability [1, 2]. The co-doping of zirconia with different REOs was reported to improve the thermal properties of thermal barrier coatings and oxidation properties due to reduction of mechanical stresses and/or porosity in the oxide layer [3, 4].

Zirconia ceramics doped with naturally occurring REOs mixtures have been prepared by hydrothermal synthesis and used as targets for obtaining ceramic coatings on high refractory Ni alloys by two physical deposition processes: EB-PBD and RF sputtering. The thermal stability and mechanical properties of coatings are discussed vs. microstructure characteristics obtained from XRD and SEM/EDAX analysis.

The results obtained on REOs-doped zirconia sintered materials with > 99% theoretical density obtained by spark plasma sintering prove that using mixed REOs as dopant increase the thermal conductivity and reduce the activation energy for the ionic conductivity in the range of 0.584 – 0.889 eV for REOs doped ZrO_2 compared to 0.718 – 0.907 eV for 8YSZ standard.

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ZIRCONIUM PEROWSKITES AS NOVEL MATERIALS FOR HIGH TEMPERATURE COATINGS DEVELOPED THROUGH COMBINATORIAL EB–PVD DEPOSITION TECHNOLOGY

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The design of space vehicles depends crucially upon databases providing the forces, moments, temperatures and heat fluxes along the chosen trajectories. In this respect the thermal-protection system (TPS) used to protect hot structures must tolerate the loads encountered along the trajectory such that the flight remains controllable until the end of space mission.

The general aim of the project is to obtain through an enhanced combinatorial EB-PVD deposition technique new thermal coatings layers on different materials as demonstrators for space re-entry vehicles. Selecting the coating materials was done taking into account a matrix of physical-chemical properties (melting temperature, resistance to chemical oxidation) and structural characteristics (minimize the substrate/coating mismatch in the nucleation stage of ad-atoms).

Based on the high thermal stability up to the melting temperature, La and Gd zirconates with perowskite structures were used as external coating materials. The thermal stability has been studied using a thermal shock equipment with air- and water-cooling gradient control. The structural modifications were monitored by high resolution SEM. The final aim is to reach coatings with thermal shock resistance up to 1700^0C.

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SECTION 5. POSTER PRESENTATIONS

THE DESIGN OF A NEW LOW WEIGHT HIGH ENTROPY ALLOY

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High entropy alloys (HEA), also known as multi-component alloys (containing tipically 5 or more elements), are able to form preponderant solid solution structures, instead of intermetallic compounds. The development of HEA represents a major challenge regarding their industrial application, due to the large number of possible combinations between the elements and their complicated structures. On the other hand, due to their superior mechanical and corrosion properties HEA can easily replace the traditional alloys, so there is an increasing interest in the scientific and industrial community on the synthesis and processing HEA composition. Light weight high entropy alloy is a new field of study in the design of industrially viable alloys and are characterized by a high strength over density ratio. In this paper an AlCuSiZnMg alloy system was studied.

The composition contains common elements, that are frequently used in light weight conventional alloys. Several compositions were modelled by thermodynamic criteria calculations and CALPHAD method, to obtain predominant solid solution structures. The selected alloy was prepared by induction melting, under protective atmosphere and was cast in a copper mould crucible. The resulted ingots proceeded to a rapid solidification process to determine the capability for the formation of advanced nonequilibrium structures. Alloy structure and property were analysed by optical microscopy, SEM-EDS, X-ray diffraction and microhardness tests.

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ENVIRONMENTAL ASSESSMENT OF FeO3@TiO2 NANOPARTICLES SYNTHESIS

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The increased volumes of industrial wastewaters containing heavy metals ions pollutants require more complex removal (and recovery) technologies which generate high costs and additional environmental impacts (due to increased energy and chemicals consumption). It is important to identify and quantify these additional (secondary) environmental impacts because there is always the risk of generating high environmental burdens when trying to solve a pressing pollution problem (like wastewater treatment). In this complex context, the aim of this study is to investigate by means of life cycle assessment the environmental impacts associated to the synthesis of FeO3@TiO2 magnetic nanoparticles at laboratory scale and their use for removal of heavy metal ions from aqueous solutions.

Life cycle assessment (LCA) uses material and energy input / output inventory analysis (LCI) and subsequent identification and quantification of associated environmental impact (LCIA). Although LCA is an accomplished method for environmental impact assessment because it enables the generation of complex environmental profiles, in the field of developing nanomaterials it has a limited use, just a few research LCA cases were developed to measure the environmental impacts of these materials. The LCI has included the lab-scale nanoparticles synthesis phase by 2 methods: conventional route by FeCl3+6H2O functionalization and a green method starting from clinker. The LCIA was performed with ReCipe 2016 at midpoint and the 18 environmental impact categories show that the conventional FeO3@TiO2 synthesis method generates considerably higher environmental impacts, as depicted in Fig.1.

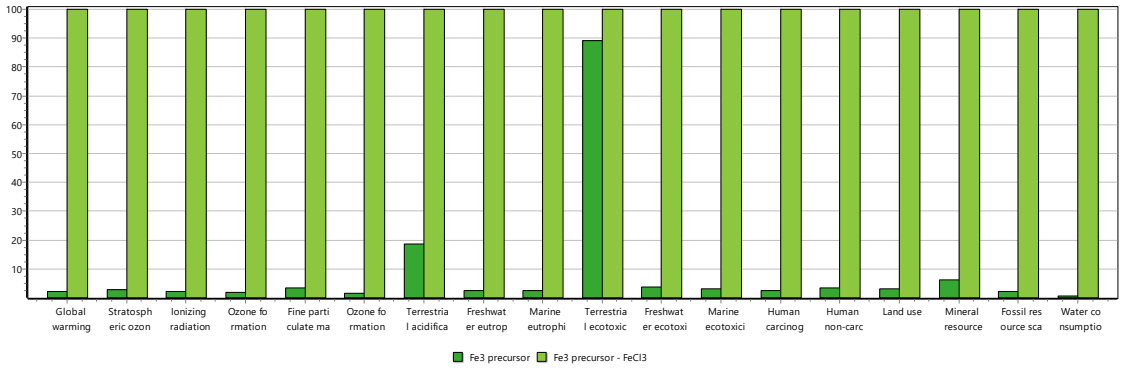

Fig.1. Environmental impacts comparison of FeO3@TiO2 synthesis alternatives

In conclusion, LCA is a valuable tool in predicting the environmental performance of materials and their synthesis methods because it enables to identify the environmental hotspots along a product life.

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HYDROTHERMAL SYNTHESIS OF MULTICOMPONENT RARE EARTH OXIDES

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Developing advanced materials with tailored properties is the driving force of the material science engineers. Recently, a new class of oxide systems, also known as High Entropy Oxides (HEO), was reported. Rost et al. [1] demonstrated that oxides systems can be entropy stabilised by synthesizing microcrystalline $Mg_{0.2}Co_{0.2}Ni_{0.2}Cu_{0.2}Zn_{0.2}O$, which exhibited a single-phase rock-salt structure.

In the present study, nanocrystalline multicomponent REO ($(La_{0.2}Sm_{0.2}Gd_{0.2}Yb_{0.2})O$ denoted LSGYN) powders were obtained by hydrothermal process. The as obtained powders were annealed in air at 1200°C. Chemical composition of LSGYN powder was determined by ICP-OES. Phase stability upon heating was tested by DSC (Differential Scanning Calorimetry), XRD (X-ray diffraction) and SEM (Scanning Electron Microscopy) analysis were performed.

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WASTE FROM POLYMER SELECTIVE LASER SINTERING AND ITS IMPACT ON ENVIRONMENT: HOW TO DO INITIAL DECONTAMINATION

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We assist today at one of the greatest challenges as regards the influence of humans on the environment: the presence of polymer microparticles in almost every corner of Earth, with dramatic consequences on the biosphere as a whole [1-5]. This problem puts pressure on the necessity to adopt novel management and business models at least as regards the manufacturing, use and end-life storage of polymers. Any such an approach must be directed towards decreasing the environment fingerprint of the production activity as much as possible. Additive manufacturing (AM) is presently developing at a rate currently estimated at 15.0% (CAGR) during 2015–2025 period [6], due to its application in various industries such as aerospace, automotive, consumer goods. More applications mean more raw material use and more resulting waste. This aspect is encountered especially in the case of selective laser sintering (SLS) of polymers. While a great part of the used polymer is recovered through sieving and re-used – in combination with fresh powder – in a new manufacturing cycle, a polymer amount still remains that is cleaned off by an anti-ex vacuum cleaner and that ends in a waste dump.

This waste sums up in time and contains polymer grains and grain aggregates full of dirt and biological contaminants such as bacteria, viruses and fungi. This waste presents a high risk of being spread in the environment and contributing to the microplastic pollution of it. It should be more beneficial to recover this powder waste and transforming it in a raw material, eventually by downgrading it, for applications other than SLS. A first step in this direction is the cleaning and decontamination of the wet powder collected from the vacuum cleaner. After that, further processing is done such as polymer melting and solidification.

It is the aim of this paper to present the experimental results obtained so far regarding the PA2200 powder cleaning and decontamination resulting from AM activities at the site of IMT. Several recipes were used for this purpose in order to select the best one. Microbiological characterization before and after decontamination was made by monitoring the presence of various types of bacteria and fungi. Morphological and spectral characterization were performed in order to determine how the reagents used for powder decontamination affect the structure of the polymer and thus its further use. All results are presented in the paper.

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THIN FILMS DEPOSITION ON GLASS USING E-GUN TECHNOLOGY FOR MEDICAL APPLICATIONS

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The purpose of this article is to characterize surface of glass coated by e-gun technology with thin films of Ta_2O_5 and ZnO. ZnO films are used in pharmaceutical industries, in cosmetics and in medicine, grace of their better anticorrosive, antibacterial and photocatalytic properties. Ta_2O_5 films have rapidly evolved in medicine research with the promise of development of new types of biomaterials used in medicine. Ta_2O_5 coatings present an excellent biocompatibility, good dielectric properties, and high corrosion resistance.

The biomaterials are realized by novel and special methods to resist of the biological reactions that occur in medical implants (protein adsorption, cell adhesion, cell growth, blood compatibility, etc.). The most important surface properties are physical properties, durability and biocompatibility. The methods to characterize biomaterial surfaces used in this work: FTIR-ATR, electrical impedance, durability in acid media, SEM and EDS.

THERMAL INVESTIGATION OF IRON OXIDE NANOMATERIALS. THE INFLUENCE OF SYNTHESIS PARAMETERS ON STRUCTURAL PROPERTIES

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Magnetic iron oxide particles are used for in vitro diagnostics for nearly 40 years. Due to the unique physical, chemical, thermal and mechanical properties of iron oxide nanoparticles, as well as their biocompatibility and low toxicity in the human body, they have been used in many biomedical applications, such as contrast agents for magnetic resonance imaging (MRI), carriers for controlled drug delivery and immunoassays, and also in magnetic hyperthermia. According to literature data, during heating in the presence of oxygen, magnetite nanoparticles are transformed into maghemite and then into hematite. At macroscopic level, oxidation of magnetite to hematite at room temperature is inhibited and changes in the crystalline structure can be achieved only by heating at 600°C. At nanometric level, changes in crystalline structure can be expected and observed at much lower temperatures even close to room temperature. This is due to enthalpy and activation energy, which depend on particle size.

Our aim is to investigate the effect of pressure and temperature on the thermal, physical and structural properties of iron oxide nanomaterials prepared by hydrothermal synthesis. Nanoparticles based on iron oxides were synthesized at temperatures of 100-200°C and working pressures between 20-1000 bar. It has been found that the synthesis pressure influences the type of the iron oxide crystalline phase. Thus, for lower pressure values (less than 100 bar), iron oxide is predominantly formed as hematite, while at pressures above 100 bar, the major crystalline phase is goethite.

The complex thermal analysis by the DSC method revealed the polymorphic changes of iron oxides at different temperatures. Thermal stability of hydrothermal synthesized nanoparticles under various experimental conditions has been demonstrated by performing complex thermal analysis: DSC-TG (including heating and cooling cycles) and DSC. The Curie temperature of the obtained iron oxides (hematite) was highlighted.

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RECYCLING OF TUNGSTEN OXIDE FROM DIAMOND CORE DRILLING CROWNS

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The paper presents results of leachability of tungsten from diamond core drilling crowns with sodium hydroxide and obtaining tungsten oxide. Hard metal scrap, in the first stages, was leached by nitric acid in the aim to dissolve cobalt, nickel, and iron. Tungsten carbide scrap was leached in sodium hydroxide in the aim to obtain sodium tungstate (Na_2WO_4).

The studied variables were: temperature, time, sodium hydroxide concentration and solid/liquid ratio. Research has shown that the optimal parameters of the leaching were: 90 °C, 240 min, and 30% NaOH. Under these conditions, tungsten recovery was 98.58% in a form of Na_2WO_4.

From sodium tungstate, tungsten acid (H_2WO_4) was, first precipitated by hydrochloric acid and purified in ammonia solution in the aim of rejecting insoluble metallic impurities. Tungsten from ammonia solution was recovered by crystallization in the form of ammonium paratungstate and calcination of WO_3.

Key words: diamond core drilling crowns, recycling, leaching, tungsten oxide

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POSSIBILITY OF USE OF AQUA REGIA FOR LEACHING THE WC-Co HARD METAL SCRAPS

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The objective of this investigation was to determine the potential for use of aqua regia for leaching cobalt from waste hard metal scpaps. Additionally, the detailed leaching kinetics of the process was studied. The studied parameters were: temperature, time, aqua regia concentration, stirring speed, and solid/liquid ratio. The hard metal with the analysis: 63.69 wt.% W, 7.85 wt.% Co, 2.58 wt.% Ni, 9.18 wt.% Fe, and 16.70 wt.% C, was used for the optimization of the process parameters. The maximal recovery of cobalt was 98.93%. It has been achieved with undiluted aqua regia at 100 °C temperature, and 90 min reaction time.

Key words: hard metal, recycling, leaching, aqua regia

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WATER SOLUBLE PORPHYRIN DERIVATIVES USED IN PLATINUM RECOVERY

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Platinum is the transitional element in the 10th group of the periodic system and is one of the most expensive and rarest elements in the earth's crust, so that its recovery from the catalysts used in automotive industry is crucial. Around 5g of platinum /automobile catalyst are usually contained [1]. Our attempts to recover platinum from leaching solutions resulted after hydrometallurgical processes, solutions that contain hexachloroplatinic acid, are based on the capacity of porphyrins to coordinate ligands at the metal centre or at the functional groups at the ring periphery [2].

This investigation aims to recover platinum in the form of colloidal nanoparticles. The first step is to coordinate hexachloroplatinic acid with a suitable functionalized free-base porphyrin or with a metalloporphyrin that is substituted at periphery with functional basic groups. The second step is to obtain platinum colloid, by reducing the already coordinated systems to Pt^0. Several porphyrins, namely: tetra-(4-aminophenyl)-porphyrin), Zn(II)-tetrakis-pyridylporphyrin, 5-(carboxy-phenyl)-10,15,20-tris-phenylporphyrin, Zn(II)-5-(pyridyl)-10,15,20-tris-(3,4-dimethoxyphenyl) porphyrin and *meso*-tetra-(sulphonatophenyl)porphyrin were used, but the most efficient structure capable to generate a complex with hexachloroplatinic acid is presented in Fig.1a and is *meso*-tetra-(sulphonatophenyl)porphyri. The removal capacity of meso-tetrasulphonatophenyl porphyrin is 94.55%. The shape of the UV-vis spectra encouraged our presumption that the porphyrin dication is formed in the presence of hexachloroplatinic acid, as presented in Fig.1b.

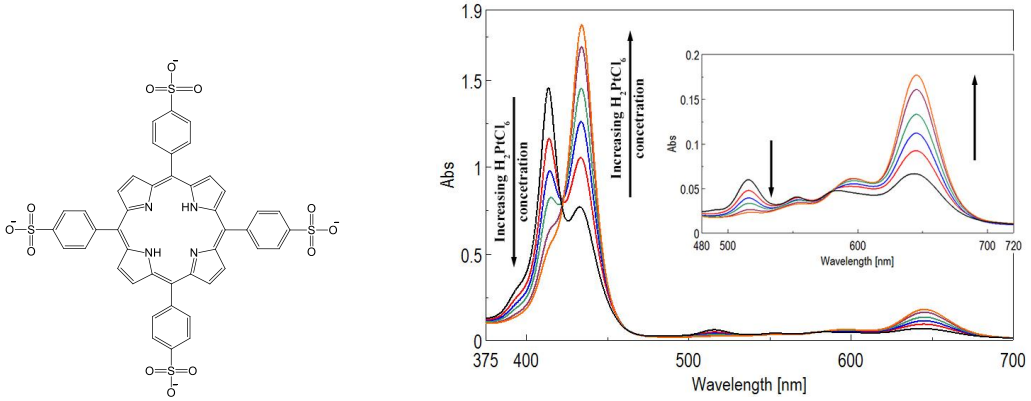

Fig.1 a) Structure of meso-tetrasulphonatophenyl porphyrin; b) overlapped UV-vis spectra showing the complex formation

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CoCrFeNiMo HIGH ENTROPY ALLOY BEHAVIOUR IN GEOTHERMAL ENVIRONMENT

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The geothermal energy represents important renewable energy resource which is reliable, cost effective, sustainable and environmentally friendly [1]. Due to the aggressive environment and the geothermal steam, which mainly consists of oxygen, hydrogen sulphide (H2S), carbon dioxide (CO2) and ammonia (NH3), the in-work components of the geothermal power plant installation, are exposed to corrosion and abrasion influencing the durability and the performance of the equipment.

High entropy alloys are known due to their improved properties as wear and corrosive resistance, making them a potential solution for this matter. In this paper CoCrFeNiMo high entropy alloy was studied and the possibility of using this alloy in geothermal steam was investigated. The high entropy alloy was processed in liquid phase using a vacuum arc remelting device, and its use will be as a coating on the in work stainless steel components.

The tests were conducted in a high temperature geothermal field, at Rreykjanesbær Power Plant, Iceland and the results obtained were optimistic in terms of using this alloy in geothermal power plant component protection.

Keywords:
Geothermal environment, high entropy alloys, corrosion.

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SCIENTIFIC RESEARCHES AND TECHNOLOGICAL DEVELOPMENTS FOR THE EFFICIENT USE OF SECONDARY METALLIC RESOURCES

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According to the policy and strategies promoted at European level, raw materials are an essential factor for the sustainable functioning of modern society [1, 2]. With a strategic position in the fields of applied inorganic chemistry and materials science, IMNR contributes to identify efficient solutions and complex technologies regarding the recovery of interest metals and their proposal to the current applications with high quality standards.

By participating in the project "Integrated eco-technology for a selective recovery of base and precious metals in Cu and Pb mining by-products - MINTECO", in the frame of Research & Innovation Program on Raw Materials to Foster Circular Economy - ERA-MIN, Joint Call 2017, IMNR values its expertise in the field of metallic secondary resources valorisation.

In partnership with institutions from Romania, France, Poland and Turkey, IMNR carries out specific research and development activities, focused on establishing laboratory and electrochemical processes in ionic liquids or other electrolytes. The studies are performed on representative samples from Baia Mare Central flotation pond, consisting of silicates, quartz, carbonates sulphates and sulphides [3, 4].

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INNOVATIVE FINISHES FOR THE IMPROVEMENT OF INDOOR AIR QUALITY

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Buildings materials are strictly related to indoor air quality (IAQ). High adsorbent materials are used as aggregates [1] to prepare unconventional mortars able to improve IAQ and TiO_2 is used as photocatalytic (PC) agent, to test also the decomposition of airborne pollutants.

In this study, 8 different types of mortar have been manufactured with traditional commercial sand, as reference aggregate, or three different adsorbent aggregates in a hydraulic lime binder (which is more sustainable than cement in terms of carbon footprint and more suitable for restoration purpose), with and without TiO_2 in order to investigate the combined effect of adsorption and photocatalysis.

Mortars have been compared in terms of mechanical strength, morphology and microstructure, hygrometric behaviour, inhibition of growth of molds and de-pollution properties.

Despite using porous materials (zeolite and activated carbon), the mechanical resistance is higher on mortar with unconventional aggregates: mortars with active carbon have the highest compressive strength, 35% higher than the reference mortars, zeolite-based mortars have 5% higher mechanical resistance than the reference one. When silica gel is used, mortars have 90% lower mechanical resistance than the reference mortar.

Mortars with sand have the lowest pore volume, followed by activated carbon mortars (with highest pores diameters) and zeolite (with smallest pores diameters). Silica gel mortars have the highest porosity.

Mortars with carbon and silica gel have the highest permeability to water vapor, more than double of the value of sand-based mortars. Mortars with zeolite have the highest moisture buffering capacity, 3 times higher than the value of conventional mortars. Silica gel- and activated carbon-based mortars absorb and desorb 1.5-2 times more water vapor than sand-based mortars.

Mortars with conventional sand show optimum inhibitory capacity against fungal growth. Silica gel mortars show a colonization 4 times higher than sand-based mortar and zeolite and active carbon gives to mortar an optimum substrate where mold can growth.

Mortars with unconventional aggregates as silica gel remove more than 80% of tracer pollutant after 2 h of test. After 90 mins, zeolite-based mortars remove 65% of initial tracer pollutant concentration. The use of TiO_2 enhance depollution properties as PC oxidation agent when, due to the quantity of pollutant already adsorbed, the specimen is close to saturation.

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NUMERICAL MODELING OF MIXED-MODE DELAMINATION FRACTURE IN UNIDIRECTIONAL AS4/PEEK COMPOSITES

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Thermoplastic composites like the AS4 carbon fiber reinforced poly-ether-ether-ketone (AS4/PEEK), generally used in aircraft structural applications, became recently very attractive for orthopedic implants, due to biocompatibility, similar modulus to bone and ability to withstand prolonged fatigue strain [1,2]. In this paper it was developed a Finite Element Method (FEM) model for the simulation of interfacial failure between two plies of an AS4/PEEK composite sample using Cohesive Zone Model (CZM), under the frame work of Comsol Multiphysics software. Mixed Mode Bending (MMB) method was considered here for the numerical implementation of progressive delamination propagating in composite specimens with pre-existing cracks.

AS4/PEEK composite model numerically investigated under the form of load-displacement curve proved to be in good agreement with test results provided in the literature (see Fig. 1), suggesting that the proposed numerical formulation can predict the strength of composite structures that suffer progressive delamination. Volumetric strain and von Mises stress at the maximum load before fracture have been computed here at different ratios between mode II strain energy rate and total strain energy rate G_{II}/G_T = 20%, 50% and 80%.

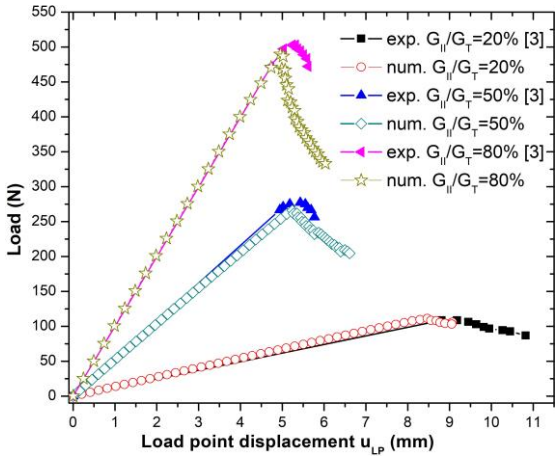

Figure 1 Predicted and experimental load-displacement curves at different G_{II}/G_T mode ratios for AS4/PEEK composite sample

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KINETICS OF COBALT NITRIC ACID LEACHING FROM DIAMOND CORE DRILLING CROWNS

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The aim of this study was to investigate the effectivity of nitric acid leaching and the leaching kinetics of cobalt from diamond core drilling crowns. The studied variables were: temperature, time, nitric acid concentration, stirring speed, and solid/liquid ratio. These parameters were optimized to process the hard metal containing: 65.94 wt.% W, 13.39 wt.% Co, 2.93 wt.% Ni, 3.32 wt.% Fe and 14.42 wt.% C. Under optimal conditions, leaching degree of cobalt was 97.35%. It has been achieved with concentration of nitric acid of 0.5 mol/dm^3, at 25°C temperature, and 120 min reaction time.

Key words: diamond core drilling crowns, recycling, nitric acid leaching

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THE BEHAVIOR OF AlCrFeNiMn HIGH ENTROPY ALLOY IN GEOTHERMAL STEAM

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The aim of this paper is to investigate the behaviour of AlCrFeNiMn HEA in geothermal environment. The geothermal steam is known doe to its high concentration in H_2S and CO_2, and because of other phenomena which occurs, like humidity, erosion and abrasion, these results in a very corrosive and aggressive environment.

AlCrFeNiMn high entropy alloy was produced in liquid state in a Vacuum Arc Remelting furnace using high purity elements in equimolar percentages. The main purpose of the study is to study the increasing the life span of the in-use equipment components of the geothermal environment. The AlCrFeNiMn high entropy alloy was tested in situ, in a high temperature field in Rreykjanesbær, Iceland, for a period time of 30 days.

Keywords: Geothermal environment, corrosion, high entropy alloys

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RUBBER CONVERSION VIA DEVULCANISATION AND ITS FURTHER PROCESSING INTO COMPOSITE MATERIALS SUITABLE FOR ENVIRONMENTAL APPLICATIONS

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Meeting the objectives of the European Commission on environmental sustainability1 an importance of clean and effective technologies for end-of-life tyres (ELTs) recycling. Here, a sustainable approached for conversion of waste materials to materials with added value is of a great importance for resource-efficient circular economy.

However, obtaining materials with added value requires a thorough multistage research, which includes traditional and emerging methods and approaches. Current article will focus mainly on devulcanised rubber research [1] for new composite materials development on the base of devulcanised crumb rubber. Particular attention will be given to materials for spilled oils collection, and for protection against electromagnetic non-ionizing irradiation.

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QUARTZ CRYSTAL MICROBALANCE COUPLED TO ASSIST THE MULTILAYER PROTEIN ASSEMBLY BY LANGMUIR BLODGETT TECHNIQUE

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Quartz crystal microbalance is a scalable microlab to realize bio complex Ac-Ag arrays in liquids or stream on air. Enzymes, ligands[1], DNA fragments[2], were anchored on coated gold quartz crystal and then made to react with bio-fragments in a dynamic liquid flow[3]. Complementary structures play a key role on the detection using crystal plate. Thus, as well known the physical principle of nanogravimetry measurement is based on frequency *(f)* shift of quartz crystal. The frequency shift is correlated to Δm with a sensitivity and limit of detection in the ng scale. Discrete Δ*f* shift values are in use to monitor the mass deposited on the plate disks, coupled with the Langmuir Blodgett technique. Due to these reasons nanogravimetry technique is an affordable rec frequency utilized to view the protein uniformity deposition in multi layers. An amino cetil enzyme example is presented for monitoring deposition on a quart crystal with a significant reproducibility of the layer by layer.

The *f* vs. time recording is a valid method to follow the correct depositions of proteins in arrays or multilayers. It is also in use to check anomaly deposition as bias or protein multi layers are utilized as platform for synchrotron radiation analysis by focused laser beam to discovery new structure folded and then to discriminate new interaction between ligands. Discrete masses as aliquots are utilized for multilayer deposition, whose gives information on the method reproducibility during preparation. In summary, nanogravimetry approached to define multi-layer proteins coupled with Langmuir Blodgett technique were presented. The *f* change showed a periodic scale decrease in the order of fraction 10.0 Hz, when quarts have this resonance. Multi protein layers are valid approach to define the structure of protein in alternative to crystalline protein[5]. The human vastness of biomarkers in serum can be employed and screening on quartz balance realized using the complementary ligand chemical structure or steric task.

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RECOVERY OF GOLD AND SILVER FROM MINING TAILS BY AMMONIUM THIOSULPHATE LEACHING

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Mining and exploitation of nonferrous ores generates huge amounts of waste, usually deposited in various impoundments or piles. These wastes can act as secondary resources for various base, strategic or precious metals but also constitute an important pollution sources for the nearby environment. In this context, the development of efficient, ecological but also economically feasible metal recovery procedures is of great interest [1].

The MINTECO project aims to develop an integrated, innovative, efficient and ecological technology for the recovery of base (Cu, Pb, Zn) and precious (Au, Ag) metals from copper and lead bearing mining wastes. For the recovery of Au and Ag, the leaching in ammonium thiosulphate in the presence of copper amine catalyser proved to meet the requirements both for efficiency and environment protection, being a promising alternative for cyanide leaching. Although the leaching efficiency of precious metals in ammonium thiosulphate is slightly lower than “classical” cyanide leaching, its low toxicity, fast leaching kinetics, relatively low unit cost and high selectivity makes it more suitable for the present needs of environmental protection [2, 3].

Tailings resulted from the flotation of nonferrous polymetallic ores from the Baia-Mare area, having a content of 0.6 g/t Au and 11 g/t Au were subjected to ammonium thiosulphate (20 g/L) leaching in the presence of copper amine (1.5 mmol/l) using a 1/3 (w/w) solid/liquid ratio, a mixing speed of 950 rpm, air flow of 2l/min and a reaction time of 4h. The method gives an extraction efficiency of 80% for Au and 60% for Ag.

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DETERMINATION OF CHEMICAL COMPOSITION AND LAYERS THICKNESS BY ICP-OES

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It is proposed a performance analytical method, fast and accurate to determine both the chemical composition and thickness. Succession of the layers deposited on different materials: glass, silicon, copper, titanium, steel could also be determined on jewellery, coins or different pieces parts.

The method is destructive and requires a quantity of material of 0.1–1g, because by successive, appropriate acid attacks, the sample is dissolved.

Analysis results are obtained by Inductive Coupled Plasma Optical Emission Spectrometry (ICP-OES) which can simultaneously detect up to 73 chemical elements in Mendeleev's periodic table at a lower detection limit. The main disadvantage of this analytical method represented by the spectral interference, which can be overcome by selecting several spectral lines for the same element, and then choosing the most suitable spectral line which shows no interferences. The ICP-OES 725 Radial Simultan spectrometer model used is provided from the Agilent Technologies company, operates in 167Al - 785Rb nm spectral range. Due to the lower detection limits, layers of submicronic medium thickness can be determined. By acid attack for performed sample we are able to successively dissolve the deposited layers, in order to obtain thickness and the chemical composition. The method is also appropriate to find chemical composition of the material support layers. To calculate the thickness of the layers it is necessary to know the area of the disaggregated sample (a sample, or part of the sample with a geometry that allows the calculation of the area is preferred). Measuring the concentration of each element found and knowing its density, we find the occupied volume. Based on the area of the disaggregated sample we calculate the average thickness of the deposited layer, for each existing element. The paper presents the calculation formulae that uses besides the sample area, the sample mass and the densities of the metals found in the sample. It should be noted that the electron beam furnace from our institute estimates the thickness of the layer deposited by weight measurements and providing it the density of the deposited element or alloy.

The method of the layers thickness developed by us is a support for optical microscopy technique, which can make the difference between the color of the layers, but cannot specify the type of the present elements. In addition, it cannot determine thicknesses under 1 micron, providing measurements only on the working sample area, while the ICP-OES method provides the mean value across the entire sample under analysis.

Determinations were done for electron beam furnace deposits, electrolytic deposits, coins, badges, jewelry, etc. determining Zn, Ni, Au, Cu, Cr, Ag, Pt, Rh, Ti, Zr ....

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ADVANCED Ti-Al-N WEAR RESISTANT COATINGS PRODUCED BY REACTIVE DC MAGNETRON SPUTTERING

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In this work, titanium-aluminum nitride (Ti-Al-N) wear resistant coatings were deposited successfully on steel substrate by reactive DC magnetron sputtering utilizing high purity Ti:Al (50:50 wt.%) sputtering target. Ti-Al-N coatings were grown on steel substrate at 25°C by employing a ratio of nitrogen:argon (N_2:Ar) gas flow of about 1:2, and by varying the deposition time (3 min, 6 min, and 9 min). After that, as deposited coatings were vacuum heat treated at 700°C for 1 h, and subjected for further characterization.

All the coated samples were investigated for surface roughness, structure, and compositional analysis by scanning electron microscopy (SEM) coupled with energy dispersive spectrometric (EDS) analysis, phase identification by X-ray diffraction (XRD) analysis, and surface hardness by instrumented indentation testing (IIT) using Oliver & Pharr calculation method. Wear studies of Ti-Al-N coatings were performed systematically for all the coated samples, too.

The morphological and structural analyses revealed smooth, uniform, and defect-free surfaces with nanocrystalline grains for all the developed coatings. The experimental results also disclose that the Ti-Al-N coatings had a higher surface hardness and improved scratch resistance than the uncoated steel samples. The good quality of the Ti-Al-N wear resistant coatings recommends them as promising candidates for surface engineered components.

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CHEMICAL AND MINERALOGICAL INVESTIGATIONS ON THE FÂNAȚE TAILINGS IN ORDER TO IDENTIFY RECOVERY DIRECTIONS

Ionuț Măcărescu, Alexandra Gabriela Pascariu, Ioana Anasiei, Daniel Cristian Mihăiescu, Alexandra Georgiana Vătui, Andreea Nicoleta Ghiţă, Dumitru Valentin Drăguţ

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The researches in this project correspond to the strategy at European and global level for the recovery of mining waste by eco-friendly and efficient methods [1; 2].

The mineralogy of the Fânaţe tailings is closely related to the nature of the pre-existing rocks that formed the Băiţa Bihor deposit and to the processes that took place during the technological flow used to extract the useful mineral substances. Also, morphological and structural changes can occur after the tailings deposit in the pond due to the phenomenon of supergene alteration of the minerals presented.

The chemical and mineralogical content can be determined by complementary methods: Inductively coupled plasma - optical emission spectrometry (ICP-OES), optical microscopy, Scanning Electron Microscopy (SEM) and X-ray Diffraction (XRD).

The chemical analysis of the Fânaţe tailings reveals the significant presence of the main metals of economic importance in the field: Pb, Zn, Cu, Mo.

Through the microscopy and DRX techniques, sulfides were detected: pyrite FeS2, chalcopyrite CuFeS2, covellite CuS, chalcocite Cu2S, galena PbS, Sphalerite ZnS, bornite Cu5FeS2. Also, gangue minerals were identified mainly quart, orthoclase, mice.

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PHASE TRANSFORMATIONS AND MICROSTRUCTURE EVOLUTION IN FERRITE-AUSTENITE BASED ALLOY

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Duplex steels are known as a mixture of two phases: ferrite and austenite. These alloys are used at high service temperatures (about 800 °C) in severe corrosive conditions [1]. Duplex stainless steels containing 20% chromium have limitations in high chloride environments, such as sea water. Super duplex stainless steel (SDSS) contains a higher amount of Cr, Ni and N typically 25%, 7% and 0.3%, respectively. SDSS have improved corrosion properties and are being used in the marine environment on the several North Sea Platforms for sea water pumps and pipes, the water injection system and firewater system [2].

During the exposure of the SDSS at high temperatures (about 800 °C) the occurring of sigma phase deeply affects the material toughness and corrosion resistance. High temperature thermodynamic data are important for studying the phase transformations at heating, particularly sigma phase behavior.

In this work the microstructural changes of stainless-steel type UNS S32760 F55 at heating were investigated and thermodynamic parameters in terms of enthalpy increments and heat flow curves are reported. Scanning electron microscopy was used to investigate the microstructural changes. Enthalpy increments, H_T-H_{298}, of the sample were obtained employing a drop calorimeter in the isothermal regime using a SETARAM high temperature calorimeter. Thermal effects of the samples in dynamic régime were measured by a TG-DSC (thermogravimetry-differential scanning calorimetry) Setaram analyzer, in temperature range from room temperature to 1300 °C. Corrosion tests were performed in the sea water environment and the results have been correlated with the SDSS structure.

The appearance and formation process of the sigma phase are investigated. Once sigma phase is formed the austenitic phase starts to be formed. A value of 9.64 J · g−1 has been estimated for enthalpy variation of 70 % austenite transformation. This is in good agreement with value reported by Raju at all. [3] for ferrite to austenite transformation in 9Cr- steels.

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NOVEL PYRAZOLONES AS ANTIMICROBIALS

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Pyrazolone compounds have gained much interest for various medicinal applications [1]. Among the pyrazolone derivatives, 3-pyrazolone and 5-pyrazolone are most important classes having a central role in pharmaceutical industry due to their bio-activity. A new ZnO catalysed multicomponent optimized synthesis of substituted pyrazolones has been realised. A one-pot four-component reaction was used to synthesize the derivatives in moderate to good yields, starting from phenylhydrazine, ethyl acetylacetate, β-naphthol and various aldehydes. The NMR spectra were performed on a Varian Inova-400 (300 MHz), in deuterated chloroform or dimethylsulfoxide (DMSO-d6). All synthesized pirazolones are evaluated by qualitative and quantitative methods against 4 bacterial strains [2].

A DFT analysis of molecular structure and frontier molecular orbitals HOMO-LUMO was performed using the GAMESS 2012 software [3]. Antimicrobial activity was correlated with electronic parameters and Mullikan atomic charges. Geometric parameters of the new pyrazolone compounds were calculated with GAMESS.

All new pyrazolones have shown good and very good antimicrobial and anti-biofilm activity, on all microbial strains tested.

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CARBON BASED MATERIALS FOR SENSORS USED IN BIO(MEDICAL) APPLICATIONS

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Research and innovation in advanced materials focuses on solving some of the world's most critical problems. Technologies based on nanocarbonic materials and their composites are moving slowly but surely towards higher TRLs. At the same time, we can see a widening of the applications portfolio. In our case, we focused on the use of Carbon-Based Nanostructures (oxidised carbon nanohorns, carbon nano-onions, graphene, nano crystalline graphene) and polymeric composites based on these, for the development of intelligent sensors.

Studying the carbon composites at molecular level and their mechanic and electronic behavior we can see that despite the fact that they are very light, those materials are very strong (ultrahigh mechanical strength) and they present a high electric conductivity. Due to their unique characteristics, the Carbon-Based Nanostructures can be seen as the materials with the greatest potential regarding the next-generation technologies [1].

We present innovative mixtures of nanocarbonic materials that can be used as solutions for sensors aiming the environmental monitoring bio-medical applications.

IDT based humidity sensors using oxidised carbon nanohorns have been already tested in various environments. Results are very promising - taking a commercial, industrial grade humidity sensor as a benchmark. We also have determined the response to mechanical stress; further investigations related to the temperature behavior are under way.

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SYNERGETIC EFFECT OF ZnO - RESIN EPOXY NANOCOMPOSITES COATINGS FOR ADVANCED APPLICATIONS

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The improvement of nanocomposites properties is based on the synergy between fillers and polymeric matrices, allowing the obtaining of multifunctional coating materials that can be adopted for widen the applicability range in advanced future applications.

The main objective of this paper consists in studying the synergistic effect of ZnO particles in the epoxy matrix, facilitating the development of nanocomposite materials with performance properties used as coating systems for different types of metallic substrates based on alloys (e.g. aluminium, titanium, iron, etc.). To obtain nanocomposites, the ex situ chemical method was used as a result of the technological advantages that ensure the component flexibility, long-term stability and property optimization. The degree of dispersion of the ZnO filler in the epoxy matrix and the compatibility of the main components were investigated by Fourier transform infrared spectrometry (FTIR), field emission scanning electron microscopy (FE-SEM), energy dispersive X-ray analysis (EDX), and the wettability of the nanocomposite coating surface was studied by contact angle measurements. The morpho-structural analysis of the ZnO-epoxy resin nanocomposite films revealed the homogeneity of the composites with the particles slightly interconnected with each other, a slight tendency to agglomerate, thus suggesting the successfully ZnO nanoparticles incorporation into the matrix.

The results of the water contact angle are in accordance with the characterizations of the composites, demonstrating that the addition of the ZnO filler in the matrix influences the wetting capacity and the hydrophobic character of the nanocomposite films compared to the matrix (water contact angle increased from 89 to 96°). Taking into account the results obtained, the efficiency of the proposed approach is revealed, and indicating that particle incorporation in the matrix can be considered a promising strategy for the use of nanocomposites as coating materials on different optimal substrates for industrial applications.

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BEHAVIOR OF AN ALUMINUM BASED METAL MATRIX NANOCOMPOSITE DURING IRRADIATION WITH HIGH POWER LASER PULSES

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Metal matrix nanocomposites (MMnC) are light metals or alloys (matrix) reinforced with nanosized elements. Such a composite material will have the properties of interest of the metal such as low weight or resistance to corrosion, but will also gain strength, ductility, wear resistance and/or elastic modulus, multiplied by orders of magnitude. However, MMnC are not widespread yet in our everyday life due to the difficulties impeded in joining these metals by conventional welding.

The main element of difficulty is to keep the nanoparticles homogeneously spread in the liquid matrix during the welding process. The aim of these experiments was to conduct welding on such materials using laser sources. An AlMg5 alloy with a dispersed phase of alumina nanoparticles was used in this study. In a first step, parameters were optimized in order to penetrate the material on a thickness of a few millimeters and to minimize porosity.

Laser power, scanning speed and attack angle were the parameters found to influence the most the welds morphology and penetration depth. Scanning electron microscopy was used for studying the welds metallographically and for investigation of the dispersed phase behavior after irradiation. Laser power tuning proved essential for obtaining a uniformly dispersed phase. A tendency of the particles to accumulate at the grain boundaries was observed for welds conducted with high laser powers.

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3D STRUCTURES OF SiO_2-ZnO MATERIALS OBTAINED BY SOL-GEL ROUTE WITH OPTICAL AND ANTIBACTERIAL PROPERTIES FOLLOWED BY 3D PRINTING

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SiO_2-ZnO materials with optical and antibacterial properties were obtained by sol-gel method. The gels were investigated by X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FT-IR) and differential thermal analysis (DTA/TG). In the FT-IR spectra were identified the characteristic bands of Si-O and Zn-O. Based on DTA/TG results, gels were thermally treated at different temperatures in order to obtain materials with optical and antibacterial properties.

The thermally treated powders were further used for 3D printing of SiO_2-ZnO structures, which have also been characterized. By XRD and FTIR methods the structures of gels, treated powders and 3D printed materials were established. The morphology and composition of gels, treated powders and 3D printed materials were established by scanning electron microscopy (SEM/ EDS). The absorption in UV-VIS was influenced by zinc addition and thermal treatment. The antibacterial properties were determined for materials treated at 700°C.

FABRICATION BY PLD OF 20%Sm-DOPED CERIA/ 20%NI-SDC THIN FILMS SUBANSABLY OF ELECTROCHEMICAL DEVICES FOR LOW AND INTERMEDIATED OPERATING TEMPERATURE

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Ceramics solid oxide fuel cells (µSOFC) and potentiometric oxygen sensor with low and intermediary operating temperatures will be developed in thin films technology by Pulsed Laser Deposition (PLD) on Si (100) using the importance of 20% SDC [1,2,3]. 20%Ni-SDC [4] is deposed on SDC at 100.000 pulses compared with 27.000 for SDC. The microstructure of this bilayer is characterized by XRD, SEM, AFM, XPS; optical characterization is made by variable spectroelipsometry. The temperatures of substrates are fixed at 500°C and 600°C. Crystalline cubic structure with good uniformity will assure further developments in these fields.

Key words: Ceramic thin films, 20%Ni-SDC/ 20%SDC/Si(100), Cubic structure, PLD, Low and Intermediate Temperature, Electrochemical devices

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THERMAL DISTRIBUTION IN MATERIALS IRRADIATED IN THE RELATIVISTIC ELECTRON FIELD

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Electron beam technology is based on powerful systems generating pulses of relativistic energy. It may be used in different applications due to its main effects: (i) the ionization and excitation of atoms and molecules and (ii) the heating of the matter. The second effect is desired mainly in applications such as melting, welding, and refining of metals and alloys although it is generally avoided in the radiation chemistry. In either case, it is essential to know the thermal behavior developed in the irradiation process either inside or outside the irradiation field. Monte Carlo simulation is an attractive method to predict accurately the thermal field features during irradiation experiments.

It requires long computing time and consumes also vast computer resources. Consequently, an analytical or semi analytical method of thermal field prediction could be useful for irradiation applications and for the improvement of the simulation methods. Generally, in order to describe the heat transfer - in dynamic or stationary regimes - in different systems, it is required to solve the Fourier heat equation or its non-Fourier (telegraph equations) extensions.

Thus, the aim of this work is to explore semi-analytical solutions of the non-Fourier heat equation. The obtained models were applied for a definite experimental case to develop properly the formalism for the heat field prediction. In this way, the thermal field of an extended target of starch subjected to the electron beam irradiation was investigated from theoretical and experimental points of view.

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A NEW COMPUTATIONAL MODEL FOR DESCRIPTION OF THE FUSION PROCESS FOR A MICRO/NANO SIZES TUNGSTEN SPHERE UNDER POWERFUL LASER IRRADIATION

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In the present work the strong laser irradiation of a micro/nano size tungsten (W) sphere sample is considered. Like practical example we choose a sphere with radius of 1 μm. Our model is valid in the radius limits: 10 nm to 1 μm. We take like heating source a laser beam with YAG/Nd:YAG/Cr^{4+}:YAG crystal. The nature of interaction between a laser beam and small dimension tungsten sample is of great importance for both theoretical and experimental point of view. In principal we have three stages: i) laser-W bulk interaction; ii) plasma formation during heating process, and iii) matter expansion. In the present study we will focus on the first two stages which take place during laser pulses interval.

We consider a heat transfer modeling for laser- (solid/liquid) interaction. For this purpose, we use the Goldenberg and Tranter (1952) [1] heat transfer model between laser beam and W sphere. We consider the W sphere being uniformly heated by the laser beam [2, 3]; and also, the fact that the W target is placed in an infinite homogeneous medium which we will consider to be a helium (He) surrounding fluid. Our study concludes that using state of the art laser beams [3] one can achieve in an ultra-short time the fusion process of small W target. The present paper could be of great interest for laser processing of metals in general and for the study W laser processing in particular.

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CARBON NANOMATERIALS AS CRM-FREE ELECTRODES FOR THE LEACHATE ELECTROCHEMICAL OXIDATION

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Electrochemical oxidation (EO) is an outstanding technology in terms of energy efficiency, effectiveness, setup dimensions and scalability, able to oxidize numerous water pollutants, without providing additional chemicals or producing waste materials. The nature of the electrode material influences the selectivity and the efficiency of the process. Conventionally adopted anodes may contain critical raw materials, such as platinum, iridium, ruthenium, and antimony; however CRM-free electrodes, such as carbon and graphite-based, exhibit a lower efficiency, and they are subjected to a faster deactivation, or, as for lead-dioxide based electrodes, they can constitute a hazard because of the release in the effluent of the coating corrosion products.

Firstly, in this study, fourteen papers focused on the electrochemical oxidation of landfill leachates, have been studied; for each study and electrode, the total current efficiencies have been calculated [1] and the criticality, in terms of supply risk and economic importance, has been estimated, by multiplying the amount of materials contained in the electrode by the indexes reported in the 2017 EU CRM List [2].

Secondly, boron-doped diamonds (BDD) and carbon nanowalls-based anodes have been synthesized, characterized, and tested for the degradation of landfill leachate.

Among the different categories of electrodes, titanium coated with a single (SMO) and mixed metal oxides (MMO), PbO_2, BDD are the most commonly used in literature for the electrochemical oxidation of landfill leachates. Noble metal electrodes (Pt) are unfeasible for real-scale applications, while amorphous-carbon electrodes (a-C) exhibits low mineralization efficiencies and high corrosion rates. Higher current efficiencies belong to the Pt and BDD electrodes, followed by PbO_2, SMO and MMO. However, excluding Pt electrodes, which criticality exceed of a 100-fold the average SMO and MMO ones, only the a-C can be considered CRM-free by the available literature. By reducing the boron doping level in BDD, from 10k to 0.5k ppm [B]/[C], it has been possible to achieve an efficient, stable electrode with a ten-fold lower CRM amount. Moreover, due to the CNW morphology, no boron incorporation it is necessary for obtaining a conductive substrate, so a CRM-free electrode has been grown, showing an increased mineralization efficiency.

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MULTI-LAYERED STRUCTURES OF METAL NITRIDE HARD COATINGS AS A SOLUTION FOR CRITICAL RAW MATERIALS PROBLEM

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A complex multilayer-in-multilayer design is demonstrated as an approach to create new materials with a periodic hard and soft phase architecture for sustainable work under extreme conditions. The main principles of microstructure formation and properties of nanostructured films consisting of periodically alternating multilayers of transition metal films CrN/ZrN and Cr/Zr pure metals, as hard and soft phases respectively, were considered.

Films were deposited by vacuum-arc evaporation of cathodes (Arc-PVD) in nitrogen atmosphere. The thickness of single Cr/Zr bilayer was 16 nm and 25 nm for CrN/ZrN bilayer with 8 and 40 bilayers in each period respectively, which was proved by SEM, RBS and TEM analyses. Hardness measured by Vickers test has values up to 29 GPa. In a couple with thick ZrN diffusion layer and complex multilayer structure it brings excellent tribological properties with good adhesion and promising high wear performance for many applications of films for service in harsh environment.

Two approaches to CRMs problem by reducing needs in steel for new tools and machine parts producing are considered: extension of lifetime for produced goods and improving of recycling efficiency. For both approaches the one solution is proposed. Superhard protective coatings with enhanced toughness provide lower wear rate for the tools and, hence, extended lifetime of each unit [1–3]. When the coating is destroyed it is easy to recycle a product by cleaning of steel base and deposition of new coating. Properties and quality exhibited by coatings will result in high performance of tools and solving problem of CRMs reduction.

Multi-Layered (CrN/ZrN)/(Cr/Zr) PVD coatings are considered as a proposed solution.

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FACILE SYNTHESIS OF SUPERAMPHIPHOBIC COATINGS FOR TEXTILES WITH SPECIAL WETTABILITY

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Superhydrophobic surfaces (bioinspired from the lotus leaf) have been extensively investigated due to the interest of their huge area of application. However, the practical use of superhydrophobic materials in real-life conditions are severely limited in the presence of organic contaminants. The surface will completely lose its superhydrophobicity once being wetted by oil [1]. Thus, for some application special antiwetting properties are desirable, to be both water and oil repellent. Obtaining of the superamphiphobic surface is much more difficult than superhydrophobic one to achieve, because the organic liquids with low surface tension readily spread on the solid substrate [2,3].

Multifunctional superamphiphobic materials have been obtained by using easily synthesized silica and zinc oxide nanoparticles and organo-modified silica (Ormosil) matrix. Nanoparticles with different sizes and shape were used in order to adjust the roughness of the coating material. For the filmogenic material in which the SiO_2 and ZnO NPs are embedded various organo-modified silane derivative were used (vinyl triethoxysilane, phenyl triethoxysilane, octyl triethoxysilane). The hydrophobic nature of the surface was ensured by the second functionalization with 1H, 1H, 2H, 2H perfluorooctyltrimethoxysilane derivative. The nanomaterials were characterized in term of composition, crystallinity size and shape, using dynamic light scattering, FTIR spectroscopy, X-ray powder diffractometry and SEM microscopy. The model textile (cotton) was treated in a twostep procedure, by dip coating the SiO_2/ZnO –Ormosil, followed by spraying the hydrophobic functional fluorinated coating.
The treated materials exhibited a contact angle (CA) of 162.5 ± 3.8 and 154.1 ± 3.5 to water and vegetable oils, respectively. In addition, after immersion in the strong acid and base solutions for 24 h, the textile surface still maintained very good antiwetting property for both water and low-tension oils.

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RECYCLING OF CRITICAL RAW MATERIALS: A CASE OF TURKEY

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Many countries seek sustainable solutions against climate change and depletion of natural resources. Critical Raw Materials (CRMs), determined and published by European Commission are crucial materials for the economy in Europe. In order to enable sustainability, recycling process of these materials of utmost important. Turkey with its boron, graphite and other important critical raw material resources, is one of the most important country as far as such materials concerned.

This study aims to underline the importance of recycling processes of CRMs by giving an overview of case studies conducted in Turkey. In order to reach this aim, data was collected from different papers, reports and sources. In addition, call interviews were also carried out. It has been concluded that; the potential for recycling of CRMs is really high, but recycling rates are quite low. Recycling processes in medicine, electronics, mechanics and other sectors should be more widely used. In order to gain real benefits from waste products, true methods for recycling should be selected. Public bodies should be more active in disseminating recycling processes. Academia should cooperate with the government for the better understanding of recycling of CRMs.

Key Words: Critical Raw Materials, Recycling, Sustainability

NOVEL SUBSTITUTED HETEROCYCLES HYBRIDS WITH ANTI-TUMOR ACTIVITIY

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Cancer is a terrible disease, which affects a major percentage of population, being spread throughout the world. For the effective treatment of forms of cancer, the drug industry has developed in recent decades, and continues to be a major interest in the scientific community. According to the scientific community, this complex disease cannot be treated with a single drug, so the general tendency is to synthesize some hybrid medicines, which contain several pharmacophore structures. Since the hybrid compounds can in principle act on several receptors, it is necessary to know the mechanism of action, so that they act targeted. [1-4]

A series of substituted heterocycle hybrids were synthesized, and characterized by IR, 1H-NMR 13C-NMR, UV-Vis, MS, elemental analysis, and tested in vitro for their anti-tumor activity. The structures of the key compounds were optimized using DFT modeling.

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THE EFFECT OF Li CONTENT ON THE STRUCTURAL PROPERTIES OF ZnO

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In thin film technology, the ZnO has seen as a crucial material due to its advantages such as direct and wide band gap in the near UV spectral region as well as large free-exciton binding energy [1-2]. Additionally, the ZnO forms in the hexagonal wurtzite crystal structure, same as GaN [3]. Its characteristics can show a change depending on deposition condition and external effect like doping. There are number of deposition technique in order to obtain ZnO films from chemical spray pyrolysis technique to sputtering. [4-5]. Also, the features of the ZnO can be altered to use in different applications as a result of change in Zn interstitials or oxygen vacancies amount in the ZnO. From the Water et al's study [6], it can be concluded that Zn atoms substitute by Li atoms in ZnO crystal structure.

This study aims to examine Li effect on the structural properties of the ZnO according to different Li percentages. For this aim, chemical spray pyrolysis technique was used in order to obtain Li doped ZnO films in the range of 0 at.% between 5 at.% of Li content. Structural properties of ZnO films as a function of Li content were evaluated by using X-ray diffraction technique. Results revealed that Li content was affected the structural properties of the ZnO.

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PLASMA FUNCTIONALIZED CARBON NANOWALLS FOR PEM FUEL CELL APPLICATIONS

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High porosity nanocarbons such as carbon black, carbon nanotubes and graphene are intensively studied as main materials in the manufacturing of microporous layer (MPL), one of the main components in PEM fuel cells (FC). MPL has the role of enhance the water/gas management and facilitate electron transfer, thus influencing both FC cost and performance. However, with low quality carbon, the corrosion of the carbon material leads to mass loss and low durability - one of the main causes which hinders large scale implementation of low-temperature fuel cells.

Obtaining high quality nanocarbons at competitive yield-to cost ratio constitutes an important objective, with plasma or pyrolytic techniques having shown promise for the bulk production of nanocarbons. We present the first results of using laser-induced graphene (LIG) foam as the MPL in PEM fuel cells. LIG method employs low-cost IR laser engravers for the laser pyrolysis of commercial polyimide substrates into graphene-based foams with distinctive 3D porous networks, enhanced stability, high electrical conductivity and good hydrophobicity. The LIG/Pt catalyst/Membrane assembly is tested on a BT-112 Single Cell Test System, showing power performance comparable to industrial quality membrane assemblies, with elevated working potential and impeccable fuel crossover for a low-cost system resulting from a highly scalable, inexpensive, and rapid manufacturing method.

Key words
Materials for energy applications, carbon nanowalls, microporous layer, PEM fuel cell

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GLUCOSE DETECTION USING PEDOT BIOACTIVE LAYER

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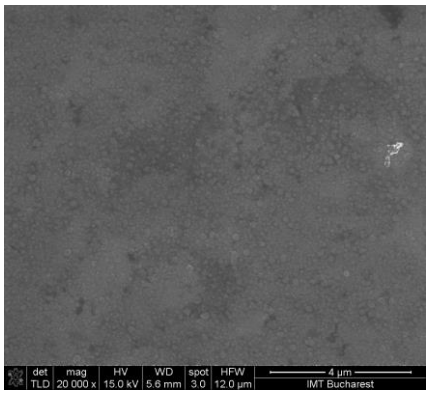
The sensitive layer for our glucose electrochemical sensor was poly 3,4-ethylendioxythiophene (PEDOT) which was deposited on the working electrode and has showed very good sensitivity and stability. The conductive polymer is used as an electrode material for amplifying the electrochemical signal received from a biological reaction with increased conducting capacities compared to other existing commercial electrodes. The PEDOT/Pt and GOx/CS/Fc/PEDOT/Pt were characterized by Raman spectroscopy, Fourier transform-infrared spectroscopy (FT-IR), and scanning electron microscopy (SEM).



SEM image of PEDOT thin film electrochemically deposited

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THE STRUCTURAL MODIFICATION OF SINGLE LAYER GRAPHENE BY OXYGEN PLASMA TREATMENT

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Single layer graphene (SLG) is the pristine graphene composed of bi-dimensional honeycomb lattice of sp^2 carbon atoms, offering remarkable properties, such as: high surface area, excellent electrical and thermal conductivity and Young's modulus~1GPa, very promising for biosensors applications. Graphene Oxide (GO) is a chemically modified graphene with epoxy, hydroxyl, carbonyl and carboxyl groups. In this paper, the synthesis of SLG was performed by Chemical Vapour Deposition (CVD) method with Plasma Pro 1000 equipment (NANOFAB 1000, Oxford Instruments, UK) [1, 2].

SLG was grown on copper substrate and then transferred by wet chemical method on gold substrate. SLG/Au was exposed to a downstream oxygen plasma in a plasma Barrel system, and we investigated the modification of the single layer graphene. Raman spectroscopy was carried on the graphene films grown on Cu and on the graphene transferred on gold before and after the oxygen plasma process, for quality and structure characterization. The SLG was characterized by Raman spectroscopy, Fourier transform-infrared spectroscopy (FT-IR) and scanning electron microscopy (SEM).

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OPTICAL PROPERTIES OF Au-YAG:Ce,Gd/PEDOT-PSS NANOCOMPOSITE

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This paper presents the methodology for the manufacturing and characterization of the yttrium based phosphors nanocomposites, such as Au-YAG:Ce,Gd/PEDOT-PSS in order to develop applications in the field of emissive optoelectronics. The synthesis process of nanocomposites involves three steps: (1) synthesis of YAG:Ce,Gd (based on a solid state method), (2) functionalization of the phosphor surface (based on a Turkevich method) and (3) embedding of phosphor nanoparticles into the polymer matrix (by ex-situ synthesis).

The morphological and structural properties of the studied composite material confirm the obtaining of a YAG:Ce,Gd nanostructured material without affecting the garnet structure by surface modification and consequently by embedding into the polymeric matrix. Photoluminescence excitation and emission spectra confirm the yellow emission of both the phosphors and the nanocomposite, but also the possibility of being used together with a blue-chip emitting at 450-460 nm for the development of a white light emission device.

The YAG:Ce,Gd luminescence properties shows emission bands centered at 560 nm and 570 nm for the Au-YAG:Ce,Gd/PEDOT-PSS nanocomposite, respectively. By comparing the optical properties of YAG:Ce,Gd and Au-YAG:Ce,Gd/PEDOT-PSS it can be concluded that both the synthesis methodology and the type of polymer used, lead to an improvement in phosphors emission parameters, representing a viable alternative to polymers already studied (PDMS, PMMA, epoxy resin) for the development of lighting systems. [1-2].

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QUANTITATIVE PHASE ANALYSIS OF CHEMICAL COMPOUNDS, CARRIED OUT BY ICP-OES

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The paper refers to the phase analysis of the chemical compounds present in ores, concentrates, slags, wastes, ash, tailings, etc. It is a united method, by bringing the sample into solution. X-ray diffraction can perform this analysis qualitative or semi-quantitative due to a software through normalization. This analysis refers to the crystalline part of the sample, the amorphous part being excluded, and the limit of detection in the best case stops at 0,1 %. There are also chemical methods: volumetric or gravimetric that selectively separate the present compounds and determine them separately.

The method proposed by us in this paper is based on the advantage of the Inductive Coupled Plasma Optical Emission Spectrometry (ICP-OES) technique that can simultaneously detect up to 73 chemical elements in Mendeleev's periodic table at a lower detection limit. The main disadvantage of this analytical method is represented by the spectral interference, which can be overcome by selecting several spectral lines for the same element, and then choosing the most suitable spectral line which shows no interferences. The ICP-OES spectrometer used is from the Agilent Technologies company, model 725 Radial Simultan with the spectral range 167Al - 785Rb nm. The general way of working is as follows: 0.25–1g homogeneous sample is attacked with royal water and brought to the flask by filtration. The filter paper is burned into the platinum capsule and then is continued with the formation of a melt by adding double carbonate mixture of Na and K and borax. The melt is removed with HCl in a separate balloon. Further dilutions are then made to obtain concentration values for each element in order to be determined by ICP-OES. The linearity field is very wide in this technique. Thus, without making specific separations, several phases of the various chemical elements can be determined simultaneously. For example, by this process, the species are determined quantitatively, quickly, and with low detection limit: Al, Al_2O_3, Si, SiO_2, Ti, TiO_2, Zr, ZrO_2.

Sulfur can be determined as sulfate if the sample is attacked only with HCl, if the sample is attacked with HNO_3, the total sulfur is determined.

In order to analyze the samples that presents silicates spinels firstly they are attacked with HF to remove Si and thus the content of bonded elements can be determined in this matter.

To determine As, Hg, ... the attack is done only with HNO_3.

To determine Sb, Sn to avoid volatile hydrides, tartaric acid is added.

A great advantage is provided by consulting the "Chemical Engineer's Manual", and the Standards of the method that describe determinations by: gravimetry, volumetry, UV-VIS or FAAS spectrophotometry can be used for dissolution, separation, up to the point of determination to be made by ICP-OES.

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