Book of Abstracts

13th International Conference

STRUCTURAL MATERIALS 2021

Bratislava, Slovakia

October 26, 2021

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Institute of Materials & Machine Mechanics, Slovak Academy of Sciences, Bratislava, Slovakia

Organizing Committee:

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Alena Opálková Šišková

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PREFACE

The Conference Structural Materials 2021 follows up on previous biennial conferences organized by Slovak Metal Science Society, which took place from 1997 in Bratislava, Košice, Trnava and Žilina. The main goal is the exchange of the latest knowledge, especially in the field of structural engineering materials. The conference also aims to create conditions for deepening existing and establishing new personal and professional contacts. The conference is focused on the following areas:

- ✓ structural materials (steels, cast irons, non-ferrous metal alloys, ceramics, polymers, composites, powder metallurgy)
- ✓ structure, properties, applications
- ✓ modification of material properties (thermal and thermochemical treatment, surface treatment, coating, etc.)
- ✓ structural analysis, mechanical and physical properties
- ✓ production, recycling, sustainability, industrial applications, etc.

13th International Conference on

STRUCTURAL MATERIALS

October 26, 2021 – Bratislava, Slovakia

Final Program

8:30 – 9:00 AM	Registration
9:00 – 9:10 AM	Introduction
9:10 – 10:40 AM	**Keynote Lectures** Session Chair: J. Jerz **(KL-1) Mechanical and physical properties of selected Mg composites and nanocomposites** Zdeněk Drozd, Zuzanka Trojanová, and Pavel Lukáč Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic **(KL-2) Alternative methods of aluminum alloys recycling in solid and semisolid state** Jure Krolo, and Branimir Lela Faculty of Electrical Engineering, Mechanical Engineering, and Naval Architecture, University of Split, Croatia **(KL-3) Textile reinforced silicate composites – challenge and opportunity** Petr Hájek[1], Tomáš Vlach[1,2], Jakub Řepka[1,2], Richard Fürst[1,2], and Jakub Hájek[1,2] [1]Faculty of Civil Engineering, Czech Technical University in Prague, Czech Republic [2]University Center for Energy Efficient Buildings, Czech Technical University in Prague, Czech Republic
10:40 – 11:00 AM	Tee/Coffee Break
11:00 AM – 1:00 PM	**Keynote Lectures** Session Chair: Z. Drozd **(KL-4) Research of steel preheat temperature and molten casting alloy AlSi9Cu3(Fe) impact speed on wear of X38CrMoV5-1 steel in high pressure** Zvonimir Dadić, Dražen Živković, and Nikša Čatipović Faculty of Electrical Engineering, Mechanical Engineering, and Naval Architecture, University of Split, Croatia **(KL-5) Examples of research activity of laboratory of non-destructive testing IFTR PAS, Warsaw Poland** Zbigniew Ranachowski Institute of Fundamental Technological Research PAS, Warsaw, Poland **(KL-6) Processes of degradation in glass textolite sujected to discharge currents action** Przemysław Ranachowski[1], Zbigniew Ranachowski[1], Piotr Papliński[2], and Stanislav Kúdela Jr.[3] [1]Institute of Fundamental Technological Research PAS, Warsaw, Poland [2]Institute of Power Engineering – Research Institute, Warsaw, Poland [3]Institute of Materials & Machine Mechanics SAS, Bratislava, Slovakia **(KL-7) Advanced characterization by Neutron Beam Techniques in the medical and industrial fields** Massimo Rogante Rogante Engineering Office, Civitanova Marche, Italy
1:00 – 2:00 PM	Lunch Break & Lab Tour
2:00 – 2:50 PM	**FIT-4-NMP Project Session** (www.fit-4-nmp.eu) Session Chair: K. Iždinský
	Project: Strategic and targeted support to incentivise talented newcomers to NMP (Nanosciences, Nanotechnologies, Materials and New Production Technologies) projects under Horizon Europe (akronym: FIT-4-NMP) **FIT-4-NMP Support Service** Giles Brandon Managing Director of Intelligentsia Consultants, Luxembourg (Coordinator of FIT-4-NMP)

	How to start in Horizon Europe with NMP research Lina Smovziuk Intelligentsia Consultants, Luxembourg
2:50 – 3:10 PM	Tee/Coffee Break
3:10 – 4:30 PM	**Oral Lectures** Session Chair: Z. Dadić **(OL-1) Microstructure and fatigue performance of additively manufactured AlSi10Mg** Tibor Varmus[1], Radomila Konečná[1], and Gianni Nicoletto[2] [1]University of Žilina, Slovakia [2]University of Parma, Italy **(OL-2) Composite material for thermal storage reinforced by aluminium foam skeleton** Arun Gopinathan, Jaroslav Jerz, and Jaroslav Kováčik [1]Institute of Materials & Machine Mechanics, SAS, Bratislava, Slovakia [2]Faculty of Materials Science and Technology in Trnava, STU Bratislava, Slovakia **(OL-3) Lightweight carbon fibre magnesium-based composites** Juraj Koráb, Stanislav Kúdela Jr., Pavol Štefánik, and František Simančík Institute of Materials & Machine Mechanics, SAS, Bratislava, Slovakia **(OL-4) Corrosion properties of PEO coated AZ31 magnesium alloy** Milan Štrbák, Filip Pastorek, Daniel Kajánek, and Branislav Hadzima University of Žilina, Slovakia
4:30 – 5:00 PM	**Poster Session** **(PS-1) Ni-NiO-Al_2O_3 porous preforms** Andrej Opálek[1*], Marta Gaburjáková[2], Peter Švec[3], Stanislav Kúdela Jr. [1], Matej Štěpánek[1], Pavol Štefánik[1], and Karol Iždinský[1] [1]Institute of Materials & Machine Mechanics, SAS, Bratislava, Slovakia [2]Institute of Molecular Physiology and Genetics, Centre of Biosciences, SAS, Bratislava, Slovakia [3]Institute of Physics, SAS, Bratislava, Slovakia **(PS-2) Effect of sintering process on the microstructure and microhardness of the powder mixture S509** Prateek Prakash Srivastava[1,2*], Naďa Beronská[1], Ľubomír Orovčík[1], Martin Nosko[1] [1]Institute of Materials & Machine Mechanics, SAS, Bratislava, Slovakia [2]Faculty of Materials Science and Technology in Trnava, STU Bratislava, Slovakia
5:00 – 5:15 PM	Closing Remarks

KL-1

Mechanical and physical properties of selected Mg composites and nanocomposites

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ABSTRACT

The influence of Inconel 718 particles and various nanoparticles (BN, Al_2O_3, ZrO_2, LaB_6, ZrB_2) on the mechanical and physical properties of magnesium has been investigated in this complex study. Ultrafine grained magnesium reinforced with nanoparticles was prepared by ball milling and hot extrusion. Magnesium samples reinforced with 0.7, 1.4 and 2.4 vol% of Inconel 718 particles were prepared using disintegrated melt deposition technique followed by hot extrusion.
The microstructures including grain size was analyzed using a FEI Quanta 200 FX scanning electron microscope equipped with EDAX EBSD camera and OIM software was utilized for EBSD observations. The phase and texture analysis was performed using X-ray diffractometer. Microhardness of samples was studied at room temperature, tensile and compression tests were performed at temperatures from room temperature up to 300 °C.
The true stress-true strain curves were determined. The flow stress is significantly influenced by test temperature; it is rapidly decreasing with increasing temperature. A substantial asymmetry in the tensile and compressive properties was observed.
The linear thermal expansion (coefficient) of studied materials was measured over a wide temperature range from room temperature up to 400 °C. Pre-deformation in both tension and compression was used to estimate the influence of dislocations and twins on the thermal expansion coefficient of nanocomposites. Internal friction was measured depending on the nanoparticles (particles) content. The results are analyzed and possible physical mechanisms are discussed.

BIOGRAPHY

Zdeněk Drozd is an associate professor at the Charles University, Faculty of Mathematics and Physics, Prague, Czech Republic. He received his PhD from Charles University, Faculty of Mathematics and Physics in 2000 (General problems in physics) and he was promoted to an associate professor at the same institution in 2008 (Physics of condensed matter). His research interests include mechanical and physical properties of magnesium alloys and magnesium base composites and nanocomposites. He is active also in the field of physics education. He was involved in several international programs focused on physics education and popularization of physics. His results in above mentioned areas of interest were presented in various journals and conferences (100 publications, approximately).

KL-2

Alternative methods of aluminum alloys recycling in solid and semisolid state

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ABSTRACT

This lecture deals with alternative methods of aluminum alloys recycling in solid and semisolid state. Recycling of aluminium as the second most commonly used metal is of extreme importance both for environment protection and the circular economy in the aluminium industry. There is a growing need for development of new recycling technologies and strategies with the aim of increasing the recovery rate for recycling of produced waste, as well as reduction of emissions of harmful pollutants into the atmosphere and mitigation of adverse environmental impact. Predictions show that the demand for aluminium at the global level will double by 2050. Problematic aluminium type of waste are machining chips due to the increased loss during conventional recycling by remelting. Part of our project is to propose alternative methods for aluminum chips recycling in solid and semisolid state in order to reduce material loss and energy consumption. First part of the lecture will explain aluminum recycling in solid state to produce quality recycled samples. Main used methods were compaction, hot extrusion and equal channel angular pressing. In second part, method based on aluminum metal foams production directly from machining chips, without commination step of the aluminum into powder, will be presented. Finally, last method will be for thixo feedstock material production directly from machining chips.

BIOGRAPHY

Dr. Jure Krolo, mag. ing. mech. was born on June 6, 1991 in Split. In October 2015 he enrolled Ph.D. study of Mechanical Engineering at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Split under the mentorship of Assoc. Prof. dr. sc. Branimir Lela. From October 2015 he works as teaching and research assistant also at FESB. He obtained Ph.D. degree in February 2021. Until now he published 23 science papers in journals and international science conferences. In addition to scientific research work, he has so far assisted in teaching at the following courses: Technology 2, Metalworking Technology, Fundamentals of Technology, Forming, Tools and Equipment, Materials 1, Materials 2. A narrower area of interest and research are forming technologies and materials. Dr. Jure Krolo has his expertise in metal forming technology and alternative methods for aluminum recycling. His main hobby at free time is spearfishing in the Adriatic sea and family life.

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- Research Interest: metal forming, materials, aluminum

KL-3

Textile reinforced silicate composites – challenge and opportunity

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ABSTRACT

Recent developments and changes in natural and socio-economic environment require new technical solutions for construction of new and modernization of existing structures. Concrete and new advanced types of silicate composites gradually become building materials with high potential for new technical solutions resulting in needed environmental impact reduction and consequent social and economic improvement.

New composite high performance silicate materials composed from HPC or UHPC and non-corrosive textile reinforcements can be used in the thin "shell" form. This enables design of elements with significantly reduced use of materials and consequently it leads to reduction of environmental impacts. Thanks to the favourable properties of this composite material, it can bring considerable advantage to the durability and thereby it can favourably affect the environmental impact.

Results of presented experimental investigation show a big potential of this advanced composite material for wider application in the construction practice. Carbon textile reinforcement has impressive mechanical parameters. The yarn data sheets show 4900 MPa tensile strength and 230 GPa modulus of elasticity and performed partial experiments confirmed these parameters. Used high-performance concrete mixture has a compressive strength measured on cubes with the edge length of 100 mm 140.3 MPa. Such mechanical properties predetermine these composites (in the form of textile reinforced concrete - TRC) for some specific applications in building construction.

The presentation will show some results of experimental investigation leading to development of structural elements using TRC. First developed lightweight slightly reinforced concrete elements were designed for non-load-bearing structures like elements of garden architecture, street furniture or facade elements. Next development could be focused on load bearing elements with higher amount of reinforcement also in more layers in combination with bar composite reinforcement. However, it will need developments of standards for design of structures using this new composite material.

BIOGRAPHY

Petr Hájek is Professor of Civil Engineering at Czech Technical University (CTU) in Prague, Faculty of Civil Engineering. Head of Department of Building Structures and Head of Laboratory of Composite Structures at University Centre for Energy Efficient Buildings.

Petr Hajek is a member of Technical Council of fib (International Federation for Structural Concrete) – chairman of Commission 7 Sustainability and head of TG 7.1 Sustainable Concrete Structures. Since 2005 he is a board member of iiSBE – International Initiative for Sustainable Built Environment and

chairman of CSBS iiSBE Czech – Czech Sustainable Building Society. He is a board member of Czech Concrete Society and chairman of editorial board of journal Beton TKS. P. Hajek has been a head of 13 research projects and co-researcher of 22 other research projects in the field of concrete sustainability and sustainability performance of buildings.

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- Research Interest: Sustainable construction of buildings, sustainable concrete structures, utilisation of advanced silicate composites, TRC, utilisation of recycled materials, LCA and complex assessment of building performance quality.

KL-4

Research of steel preheat temperature and molten casting alloy AlSi9Cu3(Fe) impact speed on wear of X38CrMoV5-1 steel in high pressure die casting conditions

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ABSTRACT

Influence of mould preheat temperature and molten aluminium alloy impact speed on total mould wear was researched using novel laboratory die casting testing equipment. Testing parameters were set to simulate HPDC of aluminium alloy AlSi9Cu3(Fe). The specimens were made from X38CrMoV5-1 hot work steel (H11). Experiment was designed using central composite design. Following the experiment design, 13 specimens were heat treated and the surface was modified by "Tenifer" nitrocarburizing. Specimen wear was measured by a tribology scale and shown graphically by 3D scan before and after the experiment; the 3D scans were overlapped to determine main wear areas. Response surface was acquired. Most influential tribological wear mechanisms were determined by ANSYS CFX 17.2 analysis. It was found that preheat temperature and molten aluminium alloy impact speed directly affects total wear of the mould surface. An increase of preheat temperature decreases total wear, while an increase of molten aluminium alloy impact speed increases total wear. Conditions for minimum and maximum wear were quantified; most significant wear was observed on sharp edges of nitrided mould material specimens. ANSYS CFX 17.2 hard particle erosion rate simulation suggested erosion occurrence mostly at impact angles perpendicular to the specimen surface. Other ANSYS CFX 17.2 simulation suggested occurrence of cavitation erosion. SEM analysis indicated an occurrence of intermetallic compounds between molten alloy and hot work steel.

BIOGRAPHY

Dr. Zvonimir Dadić has his expertise in materials used in mechanical engineering and a passion in tribology. His other research includes steel heat treatment, corrosion behavior of copper alloys, austempered ductile iron heat treatment etc. For his doctoral thesis, he did research in wear of molds used in high pressure die casting. His research was mostly concentrated on thermal fatigue and erosion of molds at high number of work cycles, using aluminium casting alloy. This was done in collaboration with the industry, company LTH Metal Cast in Benkovac, Croatia.

His scientific work was preceded by industry work in the field of mechanical engineering, specifically hydraulic and pneumatic systems. Subsequently, he started at the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Split, Croatia. At the faculty, beside his scientific work, he continued his cooperation with the industry and did a number of expertise in the area of mechanical engineering.

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KL-5

Examples of research activity of Laboratory of non-destructive testing IFTR PAS, Warsaw Poland.

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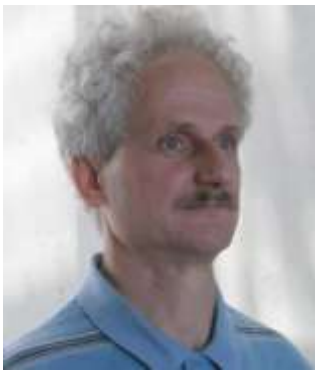
ABSTRACT

Within a presentation a short description of the Institute of Fundamental Technological Research PAS and four examples of research activity of Laboratory of non-destructive testing will be shown. The chosen activities of the Laboratory are following. (1) Developing of the instrumentation for ultrasonic detection of transversal cracks and other defect arising in exploited rail heads. The research is in progress under the financial support of Polish Railway authority. (2) Ultrasonic procedure of determination of dynamic Young Modulus of light alloy composites. The preliminary tests were performed applying the specimens delivered by IMSAS. (3) The use of acoustic emission for monitoring of duration of phase transitions occurring in steels during austempering. The presented experiments tests were carried out on bearing steel 100CrMnSi6-4 and tool steel C105U, hardened within a process of an isothermal transformation.
(4) Fault detection in a working injectors of Diesel engines using an in-house prepared instrumentation and original testing procedure.

BIOGRAPHY



Zbigniew Ranachowski is a full Professor employed at the Institute of Fundamental Technological Research, Polish Academy of Sciences, at the post of the Head of the Laboratory of non-destructive testing. His research interests are non-destructive testing methods including ultrasound and acoustic emission.
Since several years he has cooperated with IMSAS. His passions are rock climbing and contemporary history of Central Europe countries.

- Research Interest: non-destructive testing, acoustic emission

KL-6

Processes of degradation in glass textolite subjected to discharge currents action

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ABSTRACT

The work describes degradation effects in the structure of shield-centering elements made of glass textolite. Experienced elements have been taken from operated medium-voltage (MV) surge arresters. As a result of acting inner partial discharges of diverse duration and power - the material underwent degradation of different degree of advancement. Using microscopic research techniques and EDS analysis, the authors found and documented changes of structure and chemical composition of the material surface, with the increasing degree of degradation. The textolite material binder - organic resin - was melted and charred. Glass textile support was more and more exposed. As a consequence, the amount of resin-building elements (mainly carbon) on the material surface was reduced. On the other hand, the amount of elements derived from the glass fabric (silicon and metals) was increasing. Further vital conclusion was that the consequence of degradation effect of the organic binder was creation of conductive carbon paths. Ultimately, this led to device malfunctions and its final damage. This means that the performance of the system's surge protection was in hazard.

BIOGRAPHY

Przemysław Ranachowski, born in 1969, was graduated in chemistry from Warsaw University. Since 1997 he has been working at the Institute of Fundamental Technological Research, Polish Academy of Sciences (IPPT PAN). The subject of his research are the properties, parameters of the microstructure, operational durability and degradation effects in ceramic and composite materials as well as light alloys with a wide range of applications. In 2001 presented his dissertation entitled "The use of the acoustic emission method to study the dynamics of polymorphic transformations of inorganic compounds". In 2013 presented his habilitation thesis "Ageing processes in electrotechnical ceramic materials". He was co-author of about 50 papers in wide recognized journals and belongs to the experienced specialists in the field of microscopic and ultrasonic inspection of different kinds of materials.

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- Research Interest: degradation processes in ceramic and composite materials

KL-7

Advanced characterization by neutron beam techniques in the medical and industrial fields

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ABSTRACT

The adoption of neutron beam techniques (NBT), as non-destructive and non-invasive diagnostics, is becoming more and more relevant in studying materials and components of both medical and industrial interest. This paper deals with the advanced characterization by NBT, in particular at the micro- and nano-scale level, of medical devices and industrial parts. Several invasive medical devices, e.g., once implanted in the human body, as programmed to remain there for the whole patient's life, are subjected to the ionic environment of the blood and the substances and cells that secrete, as well as other aging factors. The self-expandable stent, installed in arteries such as the carotid to correct a stenosis, are also subjected to dynamic stress of the pulsation. The progress of such devices, as well as the possible improvement of materials and parts belonging to the industrial field, directly depend on the application of effective characterization methods to assess damage due to aging, in order to establish the correct relationship between the characteristics of defects and functional macroscopic properties. NBT contribute to the solution of important questions and problems related to the methodological restrictions of the analysis techniques normally used: for applications in the medical and industrial fields, the Rogante Engineering Office has developed particular methodological approaches with dedicated processing and treatment procedures. Complementary to the classical investigation methods, NBT can supply an important help in improving existing materials and devices and producing original and innovative components for different types of applications, with optimization of quality, functionality and performance.

BIOGRAPHY

Dr. Ing. Massimo Rogante, B.Eng.(Mech), Nucl. Eng. Ph.D., is the Director of the Rogante Engineering Office, operating primarily in Industrial Applications of Neutron Techniques. He has been working in the neutron field for about 30 years. He is Member of the International Scientific Advisory Committee of the Budapest Neutron Centre, the Scientific Selection Panel of the Centre of Accelerators & Nuclear Analytical Methods (Nuclear Physics Institute of the Academy of Sciences of the Czech Republic) and various other international and domestic scientific bodies, academies and projects. He published more than 300 papers and attended several International Conferences and Workshops as invited lecturer, Member of the Scientific Committee and Co-organizer.

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OL-1

Microstructure and fatigue performace of additively manufactured AlSi10Mg

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ABSTRACT

Laser powder bed fusion technology (L-PBF) can readily fabricate near-net shape metal parts. Therefore, the automotive and aerospace industries have been investigating the L-PBF production of AlSi10Mg parts because of low specific density, good hardenability, and low powder costs. Further, local melting of the atomized powder and subsequent rapid solidification generates fine structures having mechanical properties that are competitive with conventionally produced Al alloys.

If the products remain in the as-built state (i.e., no post fabrication heat treatment), residual stresses are expected in the part and are superimposed on the operating stress with often unpredictable effects on its fatigue life. As-built part surfaces are rough compared to machined surfaces with a negative influence on the fatigue strength of L-PBF AlSi10Mg parts. On the other hand, surface machining is not only expensive but often impossible for L-PBF parts due to their geometric complexity.

This study investigates the fatigue behavior of L-PBF AlSi10Mg under the combined effect of untreated condition and as-built (i.e., rough) surface quality. Three sets of miniature specimens, each with a different orientation (A, B, C) with respect to the build direction were printed in an SLM 280 HL system operating with a layer thickness of 50 μm. Each set consisted of approx. 15 samples. The as-built samples were tested in cyclic plane bending at a load ratio R = 0 at a frequency of 25 Hz and a significant directional influence on the fatigue behavior quantified. To investigate the origin of this behavior, samples for each orientation were examined using metallographic techniques to determine the structure and quality of surfaces. Surface features depending on printing strategy and printing parameters of the different specimens qualitatively explain the observed directional fatigue behavior.

BIOGRAPHY

My name is Tibor Varmus I am a Ph.D. student at the Department of Materials Engineering at the Faculty of Mechanical Engineering in Žilina. In my study, I research the influence of surface roughness on the fatigue life of materials prepared by additive manufacturing. My interests are in science and technology, the space program, the automotive and aerospace industries. In my free time I read books on the history and repair of old cars.

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- Research Interest: Additive manufacturing

OL-2

Composite material for thermal storage reinforced by aluminium foam skeleton

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ABSTRACT

Solid-liquid transitions have proven to be economically the most attractive for the use of heat storage systems. Phase Change Materials (PCMs) are able to provide extremely high energy storage density and manage to store heat at a constant temperature corresponding to their phase transition temperature. However, PCMs themselves cannot be used as a heat transfer medium. Another heat transfer medium must be therefore employed with a heat exchanger in between to transfer energy from the source to the PCM and from PCM to the load. The technical solution to avoid the low thermal conductivity is described in this contribution. Recently developed advanced heating/cooling aluminium foam ceiling panels are able to distribute homogenously heat to/from interior via a heating/cooling liquid medium. The main benefit of using these panels is that the porous structure created by thermal conductive aluminium pore walls is characterized by pores which are interlinked by microcracks in the pore walls. These open cell structure of aluminium foam with extremely low permeability allows to impregnate porous structure by PCMs and thus to achieve significantly improved thermal conductivity of resulting composite material.

Keywords: aluminium foam, energy efficiency, heat exchangers, heat storage, phase change materials

Acknowledgements: The financial support by the Slovak Research and Development Agency under the contract APVV-17-0580 (project: Research of roofing with integrated function of heat exchanger, acronym: RoofFoam) is gratefully acknowledged.

BIOGRAPHY

Arun Gopinathan is a PhD student working at the Institute of Materials & Machine Mechanics of Slovak Academy of Sciences in Bratislava (Slovakia) and currently pursuing his doctoral studies from Slovak University of Technology (Slovakia) with dissertation dedicated to the development of aluminium foam composite panels by powder metallurgy which is impregnated with PCM for developing Thermal Energy Storage (TES) system. He is working under the supervision of Dr. Jerz and involved in the project of developing and testing thermally active aluminium foam based roofing systems. His dedicated work involves the investigation of the porous structural aluminium foam in enhancing the heat transfer process and the possibility of its application in the future based TES systems.

OL-3

Lightweight carbon fibre magnesium-based composites

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ABSTRACT

The paper deals with the preparation of a lightweight composite with a metal matrix based on technically pure magnesium reinforced with continuous carbon fibres (CF). Gas pressure infiltration of molten metal into a fibrous pre-form was used for preparation of composite samples. One of the main aims of the work was to characterise mechanical properties of the composite material in longitudinal direction, related to fibres. The four-point bending test was used for characterisation of the strength and stiffness and the Dynamic Mechanical Analysis was used for non-destructive stiffness characterisation. Another aim of the work was to achieve good interfacial bond by forming stable carbides using with partially soluble or non-soluble elements in solid magnesium (Zr, Si, Y).
The material bending strength was at the level of 650 - 700 MPa and a stiffness of 250 - 350 GPa. Obtained values were approximately by 25% less than those given by simple calculation using the Rule of Mixtures. The developed Mg-CF composite should be able to form lightweight structures with an excellent strength-to-stiffness to weight ratio with excellent dimensional stability. Lightweight construction material should find various applications in space applications such as trusses, mast frames for launchers, platforms and planetary habitats, solar fields, fastening systems, kinematic holders, fastening elements, components for robots, rovers, etc.

Acknowledgement

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BIOGRAPHY

Ing. Juraj KORÁB, PhD., is a senior research fellow at the IMMM SAS. He has 22 years of experience in the field of development of Metal Matrix Composite materials prepared by gas assisted pressure infiltration of molten metals (Cu, Al, Mg, Pb) into porous preforms (carbon fibre, graphite skeleton). In the characterization field he focuses on characterisation of thermophysical properties of composites. He has experience from industrial production of electric current collector strips for electric locomotives and trolleybuses, which he gained by working at Kompozitum Ltd. as a researcher.

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OL-4

Corrosion properties of PEO coated AZ31 magnesium alloy

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ABSTRACT

Improving corrosion resistance of AZ31 magnesium alloy in environments containing chlorides by duplex surface treatment was studied. Duplex surface treatment consisted of plasma electrolytic oxidation (PEO) with subsequent sealing the coating's pores by temporary oil preservatives containing corrosion inhibitors. Evaluation of corrosion resistance was performed by using both electrochemical and exposure tests. Namely electrochemical impedance spectroscopy and potentiodynamic polarization were performed among electrochemical tests in 0.1M NaCl solution. As exposure test were chosen salt spray test according to STN EN ISO 9227 standard. The obtained results from the performed measurements confirmed significant improvement of corrosion resistance reached on AZ31 magnesium alloy by duplex surface treatment compared to the simple PEO coating and untreated one. Therefore, performed duplex treatment is a very perspective alternative for magnesium alloy applications in severe conditions or for temporary protection of magnesium products coated by PEO during marine transport.

BIOGRAPHY

Milan Štrbák is currently both researcher at Research centre UNIZA and PhD. doctoral student at university of Žilina. While studying at the University of Žilina, he studied at foreign universities in Portugal and Brazil, where he gained valuable experience. Currently, he works with corrosion and fatigue properties of modified magnesium alloys. His enthusiasm for doing research gives him the driving force to work with and meet researchers worldwide. Therefore, any experience in science and research, whether in the form of conference or research study stay, is attractive to him.

PS-1

Ni-NiO-Al_2O_3 porous preforms

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ABSTRACT

The performance of attractive Ni-based composites can be affected by changing their microstructures, e.g., introducing pores. Here, we report a novel, relatively low-cost process to fabricate Ni/Al_2O_3 composites with open porosity modified by the size of Al_2O_3 particles. The mixture of powders was subjected to thermal oxidation twice in air after a maximal temperature of 800 °C was reached in a stepwise manner and maintained for 120 min. The oxidation kinetics were determined thermogravimetrically. The open porosity was evaluated by an Archimedes' principle based method. Localization and quantification of NiO, newly formed on the Ni particle surface and acting as a mechanical bonding agent, were explored by scanning electron microscopy with energy dispersive X-ray spectroscopy and X-ray diffractometry. Larger ceramic particles prevented merging of NiO layers on adjacent Ni particles more efficiently; therefore, the open porosity increased from 21% to 24.2% when the Al_2O_3 particle diameter was increased from 5–20 μm to 32–45 μm. Because both Ni/Al_2O_3 composites exhibited similar flexural strength, the composite with larger Al_2O_3 particles and the higher open porosity could be a better candidate for infiltration by molten metal, or it can be directly used in a variety of filtration applications. the composite with larger Al_2O_3 particles could be an excellent candidate for infiltration by molten metal or it can be directly used in filtration applications requiring a good penetrating porosity, substantial corrosion resistance, and suitable mechanical strength.

BIOGRAPHY

Ing. Andrej Opalek, PhD., has his expertise in powder metallurgy and thermal analysis.

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PS-2

Effect of sintering process on the microstructure and microhardness of the powder mixture S509

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ABSTRACT

In this work, the Fe-1.8%Cr with 2% elemental nickel and 0.5% C with an additional 0.8%wt lubricant powder mixture was compacted using the uniaxial die pressing method. The sintering process was performed using the dilatometry method. A cross-section of the sintered sample was used to prepare the metallographic sample for microhardness measurement and microstructure observation. The specimens were compacted at three different pressure 600, 700, and 800 MPa. The green body was sintered with the maximum temperature of 1300 ^{o}C for four different heating rates 2.5,5.0,7.5, and 10 Kelvin/minute, and the samples were cooled down to room temperature under normal conditions. The density, microhardness, and microstructure of the sintered powder compact were investigated. The heating procedure up to sintering temperature is crucial; the majority of densification happens during this time. The experimental results indicated that a higher microhardness value is achieved at a higher heating rate. The optical micrograph shows a very similar microstructure for all the sintered samples, but the presence of different phases cannot be denied. The sample with the highest heating rate had the highest microhardness value due to the Martensite formation visible in the microstructure. The samples with the lowest heating rate have the lowest porosity and hence higher densification rate. The findings revealed that while compacting pressure and heating rate are important in creating denser parts, cooling rates must be altered to vary the microstructure.

Keywords: Microhardness, Microstructure, Dilatometry, Sintering, Martensite

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Ing. Prateek Srivastava is young Ph.D. student working with Advance materials and Materials design and has a passion for learning numerical techniques to create models and perform simulations to optimize Powder metallurgical processes.

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