KONŠTRUKČNÉ MATERIÁLY

STRUCTURAL MATERIALS

2025

Kniha príspevkov / Book of abstracts

“Veda musí začať mýtmi a ich kritikou.”

„Science must begin with myths and with the criticism of myths.“

Karl Raimund Popper

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KONŠTRUKČNÉ MATERIÁLY - STRUCTURAL MATERIALS 2025

11.11.2025, Bratislava, Slovakia

Ústav materiálov a mechaniky strojov, SAV, v. v. i. /
Institute of Materials and Machine Mechanics SAS

EDITORIAL

Konštrukčné materiály - Structural Materials 2025
Zborník / Book of Abstracts

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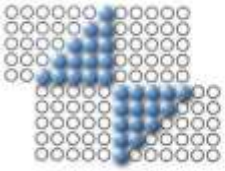
Zostavovateľ: Jaroslav Jerz

Webová stránka seminára: https://www.snmts.sk/en/structural-materials-2025/

Bratislava 2025



SNMT

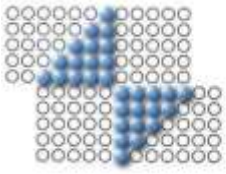
International Scientific Conference

Structural Materials 2025

Bratislava, November 11, 2025

The Conference Structural materials (SM) -2023 follows up on previous biennial conferences organized by the Slovak Metal Science Society, which took place in Bratislava, Košice, Trnava, and Žilina from 1997. 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 metallic material properties (thermal and thermochemical treatment, surface treatment, coating, etc.);
- structural analysis, mechanical and physical properties;
- production, recycling, sustainability, industrial applications, etc.



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SNMT

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) CEITEC: a case study of a successful center of excellence in materials** Pavel Krecmer CEITEC – the Central European Institute of Technology Brno University of Technology, Czech Republic **(KL-2) Microstructural aspects of the mechanical performance of Mg-LPSO alloys** Kristián Máthis and Daria Drozdenko Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic **(KL-3) Investigation of the properties of aluminous porcelain samples of a long-rod insulator subjected to high DC voltage** Przemysław Ranachowski[1], Zbigniew Ranachowski[1], Adam Brodecki[1] and Krzysztof Wieczorek[2] [1]Institute of Fundamental Technological Research Polish Academy of Sciences, Warsaw, Poland [2]Wroclaw University of Science and Technology, Wroclaw, Poland
10:40 – 11:20 AM	Tee/Coffee Break
11:20 AM – 12:20 PM	**Keynote Lectures** Session Chair: P. Ranachowski **(KL-4) Advanced characterization by atomic (neutron) techniques: probing nano/micro-structural parameters with real-world impact** Massimo Rogante Rogante Engineering Office, Civitanova Marche, Italy **(KL-5) High hardness high entropy alloy by wire arc additive manufacturing** Anatoliy Zavdoveev[1] and Massimo Rogante[2] [1]E. O. Paton Electric Welding Institute NASU, Kyiv, Ukraine [2]Rogante Engineering Office, Civitanova Marche, Italy
12:20 – 2:00 PM	Lunch Break & Lab Tour
2:00 – 3:00 PM	**Oral Lectures** Session Chair: M. Rogante **(OL-1) Precipitation during in-situ and post-heat treatments of Al-Mg-Sc-Zr alloys processed by powder-bed fusion** Štefan Nagy[1], Mohammad Sadegh Mohebbi[2] and Vasily Ploshikhin[2] [1]Institute of Materials and Machine Mechanics, SAS, Bratislava, Slovakia [2]Airbus Endowed Chair for Integrative Simulation and Engineering of Materials and Processes, University of Bremen, Germany (ISEMP) **(OL-2) Effect of precipitation annealing on mechanical properties of CoCrFeNi based complex concentrated alloys with Al and Ti additions** Alena Klimová, Michaela Štamborská, Tatiana Pelachová, Otto Bajana, Kateryna Kamyshnykova and Kateryna Ulybkina Institute of Materials and Machine Mechanics, SAS, Bratislava, Slovakia **(OL-3) Recent development in structural applications of aluminum foams** Jaroslav Kováčik[1], Jaroslav Jerz[1], František Simančík[1], Liviu Marsavina[2,3], Emanoil Linul[3], Andrei-Nicolae Bădăluţă[3] and Sergiu-Valentin Galaţanu[3] [1]Institute of Materials and Machine Mechanics, SAS, Bratislava, Slovakia [2]Romanian Academy – Timisoara Branch, Timisoara, Romania [3]Politehnica University Timisoara, Timisoara, Romania
3:00 – 3:30 PM	Closing Remarks

CEITEC: a case study of a successful center of excellence in materials

Pavel Krecmer

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ABSTRACT

CEITEC – the Central European Institute of Technology at Brno University of Technology (CEITEC BUT) – offers a compelling case study of a successful center of excellence in materials research. Formed in 2011 at the BUT campus, CEITEC BUT couples modern laboratories with open-access Core Facilities to support synthesis, processing, and multi-scale characterization of advanced materials and composites. Material research is organized under the Advanced Materials programme, with groups focused on Advanced Ceramic Materials, Cybernetics in Material Science, Advanced Polymers and Composites, and Advanced Metallic Materials and Metal-Based Composites.

This talk—"CEITEC: a case study of a successful center of excellence in materials"—will present an overview of CEITEC BUT's materials-related groups, their capabilities, and representative results, highlighting how shared facilities and cross-group collaboration accelerate method development, reproducibility, and translation to application.

BIOGRAPHY

Dr. Pavel Krecmer is Deputy Director of CEITEC BUT. He holds a PhD in Physical Chemistry from the University of Cambridge, where his postdoctoral work led to the Cambridge spin-out Polight Technologies Ltd. He later served at Rolls-Royce Fuel Cells as a group leader for advanced instrumentation, coordinating industry–academia collaborations across Europe and Asia. After returning to the Czech Republic, he led technology transfer at the University of Pardubice, coordinated CESAR JU and ESA programmes at Honeywell Advanced Technologies, and directed the NETME Centre at Brno University of Technology. A professional self-starter with broad experience in planning, securing funding, and managing research and business projects, he brings fourteen years of international academic and industrial experience, team leadership, and an entrepreneurial, adaptable mindset.

- Category: Keynote lecture
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Microstructural Aspects of the Mechanical Performance of Mg-LPSO Alloys

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ABSTRACT

A rare combination of advanced in-situ techniques with different spatio-temporal resolutions, including synchrotron diffraction and acoustic emission (AE) measurements, has been used to reveal fine microstructural details of the underlying deformation mechanisms during loading of Mg-Y-Zn alloys. In particular, the role of the arrangement of the solute-rich stacking faults forming cluster arranged layers (CALs) and nanoplates (CANaPs) or the complete long period stacking ordered (LPSO) phase in hardening has been investigated in detail. The applicability, advantages and disadvantages of different in-situ techniques to study the deformation mechanisms in Mg-LPSO alloys are discussed.

BIOGRAPHY

Prof. Dr. Kristián Máthis is an expert in the experimental study of mechanical properties of materials, with a focus on magnesium alloys. During the last decade, he has focused on the development and application of in-situ methods. He uses a combination of experimental techniques, including acoustic emission, diffraction methods and high-speed camera technology, to provide exceptional spatiotemporal resolution data on the active deformation mechanisms.

- Category: Keynote lecture
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- Research Interest: magnesium alloys, in-situ testing

Investigation of the properties of aluminous porcelain samples of a long-rod insulator subjected to high DC voltage

Przemysław Ranachowski [1], Zbigniew Ranachowski [1], Adam Brodecki [1] and Krzysztof Wieczorek [2]

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ABSTRACT

The objective of this examination was to test the aging resistance of the aluminous porcelain material C 130 type, when exposed to direct current (DC) high voltage. Long-term exposure to high DC voltages can potentially lead to various negative effects, in particular ionic current development in the porcelain material. This process may reduce the mechanical strength and, consequently, cause a failure. This problem has been noticed in the case of glass disc insulators. The samples were examined using the 3-point bending test, ultrasonic and microscopic analysis. No recordable degradation effects were found. Long-term impact of DC high voltage did not reduce the mechanical parameters or change the microstructure of the porcelain material.

BIOGRAPHY

PhD. hab. Przemysław Ranachowski is a graduate of the Faculty of Chemistry at the University of Warsaw. Since the beginning of his scientific career, he has been involved in the study of materials widely used in electrical engineering. Most of his research has focused on the relationship between technology, phase microstructure, parameters and degradation processes of electrical porcelain and composite materials. Using various methods, including acoustic, he studies the microstructure of different ceramic and composite materials, their performance parameters and resistance to ageing processes. Dr. hab. Przemysław Ranachowski has a passion for the history of architecture.

- Category: Keynote lecture
- Research Interest: Composites and Ceramic materials

Advanced characterization by atomic (neutron) techniques: probing nano/micro-structural parameters with real-world impact

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ABSTRACT

The advancement of industrial materials and components strongly depends on effective characterization methods capable of linking macroscopic functional properties with nano- and microstructural features. Neutron beam techniques (NBT), non-destructive and non-invasive, represent powerful tools to probe such relationships, overcoming many limitations of conventional analysis methods. At the Rogante Engineering Office (REO), dedicated methodological approaches procedures are developed to broaden the industrial applicability of these atomic techniques. NBT provide fundamental insights into key physical parameters linked to performance, degradation and overall quality, supporting improvements in properties and functionality. Their impact is increasingly significant in both industrial and medical fields, e.g., in the study of invasive medical devices, which require to assess aging and defect evolution. Similar demands exist in various industrial sectors, where components must guarantee long-term durability and structural reliability. NBT, added to classical analyses, offer complementary diagnostics that strengthen quality control, and promote the development of new-generation materials. By bridging microstructural characterization with macroscopic behavior, they enable optimization of design, performance and service life of both biomedical and industrial products. This paper presents new case studies carried out by the REO, e.g., illustrating advanced nano/micro-characterization of duplex stainless steels for biomedical applications and high-entropy alloys fabricated by wire arc additive manufacturing. These examples highlight the broad potential of NBT to drive technological progress and deliver real-world impact.

BIOGRAPHY

Dr. Ing. Massimo Rogante, B.Eng. (Mech.), Ph.D. in Nuclear Engineering, is Director of the Rogante Engineering Office, landmark for application of neutron techniques in the industrial and cultural heritage topics. With ~30 years of experience in the neutron field, he is an active member of several leading international organizations, including the Int. Scientific Advisory Council of the Budapest Neutron Centre and the Scientific Selection Panel of the CANAM at the Nuclear Physics Institute of the Czech Academy of Sciences. He has contributed to various international and national projects, published over 360 scientific papers and frequently serves as invited lecturer, scientific committee member and co-organizer at int. conferences and workshops. He is also a Maestro of piano.

- Category: Keynote lecture
- LinkedIn: https://www.linkedin.com/in/massimo-rogante/
- Research Interest: Materials Science, Nuclear Science

High hardness high entropy alloy by wire arc additive manufacturing

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ABSTRACT

High-entropy alloys (HEAs) are a relatively new class of materials that are based on multi component principle alloying elements approach forming supersaturated solid solution. Such alloys are composed of alloying elements in equal proportions. These materials have been found to have exceptional mechanical properties, such as high strength, ductility, corrosion and wear resistance, making them perspective for a variety of applications.
Combining WAAM with HEAs can offer a number of advantages. The most valuable is a cost-effective and efficient process for producing large-scale components. In the case of soft HEAs (such as Cantor), it is possible to manufacture solid wire or use multi-component wires cord. However, treating high-hardness alloy it becomes impossible to fabricate solid wire with appropriate composition. The solution to such a complex technological task is proposed in the current work.
The proposed method is based on gas metal arc welding (GMAW) with metal powder-cored wires (MPCW). The filling of the wire contains powder components in equal amounts relative to each other. Such an approach is beneficial compares with alternative methods of obtaining bulk alloy as melting in vacuum or argon-plasma melting, firstly due to the predominance in the molten volume of the workpiece. Further development of this approach is discussed on the example of a high hardness eutectic high entropy FeCoNiAl alloying system doped with Ta. The WAAMed alloy is characterized by almost zero plasticity, which is become prominent after the application of the special heat treatment procedure.

BIOGRAPHY

Dr. Zavdoveev has expertise in material science and passion in high entropy alloys.

- Category: Keynote lecture
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- Research Interest: HEAs

Precipitation during in-situ and post-heat treatments of Al-Mg-Sc-Zr alloys processed by powder-bed fusion

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ABSTRACT

This study explores the evolution of Sc-rich precipitates in Scalmalloy® fabricated via Powder Bed Fusion (PBF) additive manufacturing. Through a combination of microstructural characterization, thermodynamic modeling, and an adapted precipitation model, we investigate how these precipitates evolve during solidification, in situ heat treatment (IHT), and post-heat treatment (PHT). A comprehensive classification framework is established for primary and secondary Sc-rich precipitates, based on their origin, location, morphology, composition, interactions, and size. Primary precipitates are predominantly found within the fine-grained (FG) zone, with their characteristics indicating further transformation during IHT and PHT. The developed precipitation model, integrated with multiscale thermal simulations, successfully predicts the formation of fine, homogeneous secondary $L1_2$-Al_3Sc precipitates during PBF and PHT, demonstrating its value as a tool for optimizing PBF processes in components with complex geometries and varying thermal profiles. Our results show that the applied IHT conditions did not trigger secondary precipitation, whereas subsequent PHT at 400 °C for 1 hour promoted the formation of secondary precipitates through both continuous and discontinuous mechanisms. Future work should focus on resolving current uncertainties in primary precipitate formation during PBF and incorporating both homogeneous and heterogeneous nucleation mechanisms to enhance understanding of Scalmalloy® precipitation behavior and PBF process optimization.

Acknowledgment: Funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V04-00715.

BIOGRAPHY

Ing. Stefan Nagy, Ph.D., is currently a researcher at the Institute of Materials and Machine Mechanics of the Slovak Academy of Sciences. He completed both Engineering and Doctoral studies at the Faculty of Materials Technology, STU, in the field of Advanced Materials and Material Design. The area of his expertise is metal matrix composite materials, aluminium alloys, additive manufacturing, and electron microscopy (TEM, STEM, SEM).

- Category: Oral lecture
- Research Interest: additive manufacturing, composites, electron microscopy

Effect of precipitation annealing on mechanical properties of CoCrFeNi based complex concentrated alloys with Al and Ti additions

Alena Klimová, Michaela Štamborská, Tatiana Pelachová, Otto Bajana, Kateryna Kamyshnyková, Kateryna Ulybkina
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ABSTRACT

Complex concentrated alloys with nominal composition $CoCrFeNiAl_{0.35}$ and $CoCrFeNi(Al,Ti)_{0.35}$ (in molar fraction) were prepared by vacuum induction melting in a ceramic crucible and tilt casting into a cylindrical ceramic mould. As-cast ingots were subjected to the solution annealing and multi-step hot forging followed by recrystallization annealing with the aim to achieve evenly distributed equiaxed grains. The evolution of precipitation hardening of FCC(A1) matrix by secondary phase particles was studied at the temperatures from 700 to 1000 °C for 2 up to 1000 hrs. Microhardness measurements indicated the highest level of precipitation hardening during annealing at the temperature of 700 °C in $CoCrFeNiAl_{0.35}$ alloy and 750 °C in $CoCrFeNi(Al,Ti)_{0.35}$. In $CoCrFeNi(Al,Ti)_{0.35}$ alloy annealed at 700 - 800 °C formation of $L1_2$ nanoprecipitates inside the grains was revealed by TEM and discontinuously precipitated phases enriched by Al, Ni and Ti were observed on the grain boundaries. In $CoCrFeNiAl_{0.35}$ alloy BCC(B2) particles are formed in the studied temperature range and $L1_2$ nanoprecipitates were observed only after annealing at 700 °C. The effect of annealing time at 750 °C of $CoCrFeNi(Al,Ti)_{0.35}$ alloy on tensile properties was investigated. Relation between discontinuous precipitation and fracture mode was elucidated. Tensile properties of studied alloys after precipitation annealing at 700 and 900 °C were compared. Product of strength and elongation in tested precipitation strengthened $CoCrFeNi(Al,Ti)_{0.35}$ samples reached the value between 38 and 45 GPa, while in $CoCrFeNiAl_{0.35}$ samples only 19.6 GPa.

Acknowledgment: This work was financially supported by the Slovak Grant Agency for Science under the contract VEGA 2/0018/22, the Slovak Research and Development Agency under the contracts APVV-20-0505 and APVV-23-0206 and the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I04-03-V02-00005.

BIOGRAPHY

Dr. Alena Klimová has expertise in conducting experiments and developing methodologies for heat treatment of materials, solidification, qualitative and quantitative evaluation of microstructure and chemical composition, and testing of materials. The object of her interest is the research of materials for high-temperature applications and high entropy alloys with resistance to hydrogen embrittlement.

- Category: Oral lecture

Recent development in structural applications of aluminum foams

Jaroslav Kováčik[1], Jaroslav Jerz[1], František Simančík[1], Liviu Marsavina[2,3], Emanoil Linul[3], Andrei-Nicolae Bădăluță[3], Sergiu-Valentin Galaţanu[3]
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ABSTRACT

The recent development of structural components made from aluminium foams and reinforced aluminium foams will be presented. The basic concept for the design and manufacturing of lightweight load-bearing aluminium foam panels will be introduced. The concept is based on the utilization of reinforcing or structural elements within surface skin or even in foam volume (gradient structure), such as metallic or ceramic parts, tubes, profiles, wires, or woven fibres with grids of various mesh sizes. One of the attractions of the process is that the composites are prepared in one technological operation (during foaming) what significantly reduces manufacturing costs. Further the basic mechanical properties of aluminium foams and reinforced aluminium foams will be presented with respect to type and size of reinforcement obtained under various loading conditions. Finally, the potential applications of aluminium foams will be shortly discussed.

Acknowledgment: The financial support by the Slovak Grant Agency for Science under the contract VEGA 2/0102/25 (project: Aluminium foam reinforced bio-based phase change materials for latent heat storage) and by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I04-03-V02-00033 (REBECCA) is gratefully acknowledged.

BIOGRAPHY

Dr. Kováčik has his expertise in metallic foams. He is involved in the investigation of foams' mechanical and physical properties and in their modelling. Further, he is interested in metal matrix composites, focused on the physical and mechanical properties of copper–graphite materials. He also deals with the powder metallurgical preparation of Ti and Ti composites via the warm powder method and the use of concentrated solar power for their sintering and nitridation.

- Category: Oral lecture
- LinkedIn: https://www.linkedin.com/in/jaroslav-kovacik-a5a1a410/
- Research Interest: composites, foams, concentrated solar energy

Zoznam účastníkov / List of Participants

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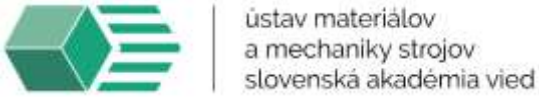

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