Questionnaire
Summary of the main activities of a research institute of the Slovak Academy of Sciences

Period: January 1, 2016 - December 31, 2021

1. Basic information on the institute:

1.1. Legal name and address

Institute of Materials Research of the Slovak Academy of Sciences
Watsonova 47, 040 01 Košice, Slovakia

1.2. URL of the institute web site [redacted]umv.saske.sk **https://umv.saske.sk**

1.3. Executive body of the institute and its composition

Directoriat	Name	Year of birth	Years in the position, from - to
Director	doc. RNDr. Pavol Hvizdoš, DrSc.	56	2014 -
Deputy director	RNDr. Ján Mihalik	61	2006 -
Scientific secretary	Ing. Alexandra Kovalčíková, PhD.	40	2021 -

Add more rows for any changes during the evaluation period

1.4. Head of the Scientific Board Ing. Ľubomír Medvecký, PhD. from 2013 -

1.4.1 Composition of the International Advisory Board

Dr. Csaba Balázsi
Institute for Tech. Physics and Mat. Science
Centre for Energy Research
Hungarian Academy of Sciences
Konkoly-Thege M. 29-33
1121 Budapest
Hungary

Dr. inż. Łukasz Ciupiński
Warsaw University of Technology,
Research Centre “Functional Materials”
141 Wołoska str.
02-507
Warsaw
Poland

Prof. Bikramjit Basu, PhD
Materials Research Center
Indian Institute of Science
Bangalore – 560012
Karnataka
INDIA

1.5. Basic information on the research personnel

1.5.1. Fulltime equivalent work capacity of all employees (FTE all), FTE of employees with university degrees engaged in research projects (FTE researchers)

2016		2017		2018		2019		2020		2021		2016-2021	
FTE all	FTE researchers	FTE all	FTE researchers	FTE all	FTE researchers	FTE all	FTE researchers	FTE all	FTE researchers	FTE all	FTE researchers	average FTE all per year	average FTE researchers per year
55,00	44,16	56,00	44,20	57,00	46,70	54,00	47,36	57,00	51,81	59,00	55,24	**56,33**	**48,25**

1.5.2. If applicable, add also a short information on the merger of the institute in the evaluation period. You can also add rows in the above table corresponding to the founding institutes

1.6. Basic information on the funding of the institute

1.6.1. Institutional salary budget, other salary budget[1], non-salary budget[2]

Salary budget	2016	2017	2018	2019	2020	2021	average
Institutional salary budget *[millions of EUR]*	0,884	0,946	1,027	1,269	1,432	1,453	**1,169**
Other salary budget *[millions of EUR]*	0,126	0,185	0,220	0,342	0,345	0,564	**0,297**
Total salary budget *[millions of EUR]*	1,010	1,130	1,248	1,611	1,777	2,018	**1,466**
Non-salary budget *[millions of EUR]*	0,661	0,690	0,739	0,866	0,834	0,845	**0,772**

1.7. Mission Statement of the Institute as presented in the Foundation Charter indicating the years when it was adopted and revised

The Institute was founded in 1955 as the Laboratory of Engineering and Metallurgical Technologies of the Technical University in Košice. In 1970 it was incorporated into the Slovak Academy of Sciences as the Institute of Experimental Metallurgy. This name was changed to the Institute of Materials Research of the Slovak Academy of Sciences (IMR SAS) in 1992.

The Institute was established as a part of Division I of the Physical Sciences of the Slovak Academy of Sciences, which has its headquarters in Bratislava. Research at the Institute is orientated on development and testing of new materials and technologies with the emphasis to wide international collaboration. The Institute has approximately 80 employees, including scientific and research workers, PhD students, technicians and administrative staff.

The Institute is a governmental non-profit organization funded by the Government of the Slovak Republic and by finances from ongoing projects. They include national and international scientific grants supported by Slovak grant agencies and various international

[1] Salary budget originating outside the regular budgetary resources of the organization, e.g. from the project funding.
[2] Includes Goods and Services and PhD fellowships

programs as well as collaborations with commercial sector, industrial establishments, universities and research institutes.

The main tasks of the Institute in basic and applied research include development and testing of new materials and technologies, to educate and to train undergraduate and PhD students (Materials Science and Materials Engineering) and to develop new testing/characterization methods and standards. Its activities are oriented towards the study of transformation and transport phenomena taking place in microstructure of materials of different chemical nature (metals, ceramics, etc.) and internal state (crystalline, amorphous, etc.). Further research activities involve studies of the influence of chemical composition, microstructure and other external factors as loading conditions, temperature, environment etc., on mechanical and physical properties of the materials as well as on their reliability and durability. This research contributes directly and indirectly to the development of advanced technologies, functional and structural materials including steels, materials made by powder metallurgy, ceramics, bioceramics, composites and nano-composites. A particular activity of the Institute includes prototype production of specific components via powder metallurgy.

1.8. Summary of R&D activity pursued by the institute during the evaluation period in both national and international contexts. Describe the scientific importance and societal impact of each important result/discovery. Explain on general level – the information should be understandable for a non-specialist (recommended 5 pages, max. 10 pages for larger institutes with more than 50 average FTE researchers per year as per Table 1.5.1.)

During the assessed period the Institute of Materials Research of SAS was active in the following main research areas:

I) advanced metallic materials (steels, non-ferrous materials, advanced alloys);
II) advanced structural ceramics and non-metallic materials;
III) hybrid materials, biomaterials, functional materials.

The research activities were carried out within national (VEGA, APVV, etc.) projects and international (ERA-NET, COST, EU Structural Funds etc.) projects.

I) A**dvanced metallic materials**:

I.A Electrical steels for electric cars and hybrid engines

In the field of soft magnetic materials research, projects focused on the development of microstructural and textural parameters of electrical steels through deformation-induced movement of ferrite grain boundaries under the influence of a gradient of internal deformation stresses in combination with dynamic heat treatment with extremely high heating temperatures. The improvement of the magnetic properties of electrical steels with a coarse-grained microstructure was realized by means of "laser scribing" technology, which enables efficient, fast and efficient refinement (modification) of the surface domain structure of the investigated steels. (projects: APVV-15-0259, VEGA 2/0073/19, APVV-18-0207, VEGA 2/0120/15, VEGA 2/0066/18).

I.B Gradient materials for engineering applications

The most significant results in the national and international context were: within the technologies used in the automotive industry, the modification of the clinching method based on local intensive heating of the joint zone increased its strength by 60%; In die-casting technology of aluminum alloys, the service life of mold parts based on local laser heating and duplex PVD coating was increased by approx. 60,000 casting cycles. (projects: APVV 17-0381, APVV 16-0359, APVV 16-0194, APVV 14-0384).

I.C Heat-resistant steels and welds for high-efficiency energy boiler equipment

Based on the research of thermal degradation of welds, an unconventional heat treatment was proposed leading to the extension of their creep service life. The influence of rejuvenation annealing conditions on the restoration of mechanical properties of thermally degraded materials was clarified. (projects: VEGA 2/0151/16, VEGA 2/0062/19).

I.D Tool steels and metal-ceramic composites for demanding friction applications

In order to improve the properties of tool steels, research projects focused on surface treatment by means of coherent laser radiation were implemented. The work was focused on the analysis of the microstructure and the proportion of different phases in the sub-surface layers by applying conventional heat treatment in combination with laser treatment so as to improve the abrasion resistance properties of the affected layers compared to the conventional procedure. Pulsed electric current sintering has developed structurally stable, high-strength and abrasion-resistant composite materials based on Mg and Al with various proportions of GNPs, Al2O3 and B4C. (Projects: VEGA 2/0081/16, COST MP1401, APVV SK-UA-21-0023, VEGA 2/0101/20).

I.E Modeling of phase diagrams and development of thermodynamic databases

Parameter databases have been developed for all types of thermodynamic calculations of ternary systems B-Fe-Mn, B-Fe-W, Al-Pd-Co and their binary subsystems. The optimization of the ternary parameters of the complex Fe-B-Cr-V-Mn system was achieved. Databases expand the possibilities of predicting the thermodynamic properties of newly developed materials and can also be used for modeling diffusion processes. (projects: VEGA 2/0073/18, APVV-15-0049, VEGA 2/0153/15, MAD SAV-AV ČR 15-11).

I.F Nanocomposite materials for ballistic protection

A nanocomposite material based on B4C-TiB2-GNPs in the form of hexagonal plates was developed and ballistically tested and successfully integrated into the final ballistic plate, which is a basic component of an individual's ballistic vest. (project: SEMOD-75-2 / 2019).

I.G Nanocomposite materials based on magnesium alloys

The positive effect of intense plastic deformations on dispersion-strengthened Mg alloys by Al2O3, SiC and CNT particles on mechanical properties, tribology, etc. was demonstrated. Laser modification of alloys surfaces proved their wide use in technical practice. (projects: VEGA 2/0118/14, VEGA 2/0080/17).

I.H Nanocomposite materials for high temperature applications

The result of the project research was the structural optimization of a nanocrystalline Cu composite with temperature stability at 900 °C. The proposed electrodes have inproved tested life (3x campaign) in comparison with commercially used Cu (Cr) material. (project: VEGA 2/0141/19).

I.I New types of lead-free solders

The project developed new types of alloys suitable for connecting high-performance electronics. The practical use of the alloys designed and produced by us was tested in semi-industrial conditions (project APVV-14-0085).

I.J Alloys for biomedical applications

Several systems of biodegradable and/or bioresorbable alloys based on Zn, Ca and Mg. The alloys have been tested for mechanical support, degradation rate and biocompatibility of future personalized intra-body implants. A new type of recyclable respirator filter materials has been designed to provide effective protection against SARS-CoV-2 viruses. (Projects: VEGA 2/0021/16, VEGA 2/0013/19, APVV-17-0008, APVV-20-0068, PP-COVID-20-0025).

I.K Metal hydride alloys for efficient hydrogen storage

We have developed new types of metal glasses in the Mg-Ca-Ni-Cu system which have been comprehensively tested in terms of their storage capacity, hydrogen absorption and desorption kinetics (project APVV-15-0202).

I.L Laminated materials for geothermal applications

We have characterized completely new types of bimetallic materials prepared by blast welding. These materials are demonstrably usable in the environment of the geothermal industry, heat exchangers, expansion vessels or in distribution pipes (ERANET project - ExploGuard).

II) Advanced structural ceramics and non-metallic materials

The scientific-research activities are focused on the research and development of advanced ceramic materials, their composites and nanocomposites, nano/microfibers, thin ceramic layers, and coatings. The main aim of the research and development was to understand the processing – microstructure – properties relationships at development of different systems. For this we applied detailed: Microstructure and chemical characterization of the prepared/developed systems at atomic/nano/micro level – X–ray, SEM; Tests of mechanical and functional properties at micro/macro level – testing in four-point bending / Weibull analysis, fracture toughness (IF, IS, SENB, SEVNB), indentation methods – hardness, fracture toughness, fatigue, electrical and thermal conductivity, etc.; Tribological testing; High temperature testing – oxidation, thermal shock.

II.A Processing and characterization of advanced ceramics and ceramic based composites:

The activities in this area of research are focusing on the development of ceramic composites with carbon based fillers, ultrahigh temperature ceramics (UHTC) with significantly improved oxidation and ablation resistance and just recently developed High – Entropy Ceramics (HEC) based on transition carbides and nitrides. The research and development in this area was realized in very strong national and international collaboration with IACh SAS and teams from Hungary, England, Germany, Poland, etc. The main processing routes used were spark plasma sintering (SPS) and hot pressing (HP). Our studies involve following systems: Progressive ceramic composites with carbon based fillers - Si_3N_4, SiC, B_4C, CNTs – carbon nanotubes, GPLs – graphene platelets, etc). Ultra-high temperature ceramics (UHTC): with significantly improved oxidation and ablation resistance for use in extreme temperature conditions above 2000 °C for aerospace applications, etc., – ZrB_2, TiB_2 based composites. High-Entropy Ceramics (HEC): based on metal carbides and nitrides with improved room and high/ultra-high temperature properties suitable for extreme operating conditions as thermal protection materials on hypersonic aerospace vehicles etc as (Hf-Ta-Zr-Nb-Ti)C and (Mo-Nb-Ta-V-W)C, etc. (Projects: VEGA 2/0118/20, VEGA 2/0091/18, VEGA 2/0163/16, 2/0130/17, APVV-15-0469, APVV-19-0497, APVV-17-0328).

II.B Processing and characterization of thin coatings

Since 2017, the activities in the field of thin coatings were solved as principal investigator within 2 APVV projects (APVV 17-0320 (2018-2021) and APVV 14-0173 (2015-2018)), 1 VEGA project (VEGA 2-0017-19 (2019-2021) and 2 international projects (M-ERA Rus Plus (2015-2017) and V-4-Japan Joint Research Program on Advanced Materials (2021-2024)). They were focused on the optimization of the deposition conditions and properties of hard, superhard, and alternatively, functional coatings for engineering applications with nanocomposite, multilayer and/or gradient structures from single- to multi-component material systems prepared by the newest PVD technologies as High Power Impulse Magnetron Sputtering – (HiPIMS and High-Target Utilization Sputtering (HiTUS).The optimization of the deposition processes in each technology is based on the mechanical and tribological properties of HiPIMS and HiTUS made coatings in comparison with the properties of the reference coatings deposited by DC magnetron sputtering. Our studies involve following systems: metal (W, Ti, Cr, Si) doped diamond like carbon coatings, nanocomposite to amorphous W-C/a-C:H coatings; Cr-N coatings prepared by reactive HiPIMS and HiTUS; multi-component CrB_2 and ZrB_2 -based coatings doped with additional metals (V, Ta, Ti, etc.); multi-component Hf-Ti-Zr-transition metal -based nitride and carbide coatings corresponding to ultra-high temperature high entropy ceramic coatings.

II.C Processing and characterization of nano/microfibers and their composites

The activities in this field of our research are focused on the development and characterization of polymer, ceramic, and carbon nano/microfibers with the aid of technology of needle-less electrospinning from the free surface of the polymer solution on the machine NANOSPIDER. Potential applications in the field of gas sensors, solar cells, photocatalysts, hydrogen evolution electrode materials and also as fillers for composites with a ceramic matrix. Our studies involve following systems: prepare continual fibers with an average 50 – 700 nm in the form of unwoven textile with a width up to 350 mm; spin a wide spectrum of synthetic and natural polymers: PVA, PA-6, PAN, PUR, PEO, PVP, chitosan, collagen, PLA, PCL, HA; consequently from the precursor fibers produce ceramic oxide fibers – Al_2O_3, Fe_3O_4, TiO_2, SnO_2, ZrO_2 and both pure or nanoparticles-modified carbon fibers with controlled porosity. (Projects: VEGA 2/0099/18, PP-Covid-20-0025, APVV-17-0625).

III) Hybrid materials, biomaterials and functional materials

III.A PM based Soft magnetic materials: In the field of powder magnetic materials, research focused on the design of the structure and functional properties of magnetically soft composite materials. Our research team was one of the first to successfully prepare a composite material with a magnetically active dielectric and to prove its positive effect experimentally. The formulated relationship of irreversible permeability to premagnetization losses gives the possibility to understand the interrelationship of a quantity such as permeability and for losses - a quantity often used in practice. Analysis of the correlations of the structure and properties of perovskite ceramics has shown that in the case of fine microstructure, the high value of dielectric permittivity is due to the extremely high density of domain walls and polar nano-regions. The large piezoelectric coefficient of coarse-grained ceramics is the result of a high degree of domain arrangement after polarization. For the first time, the detailed study of magnetic interactions at the interface of ferromagnetic and ferroelectric phases has theoretically described the origin and development of multiferroic skyrmions, the properties of which have a huge potential for usability in the next generation of integrated circuits and digital memories. Based on WoS analysis, the researchers are in the top ten authors most publishing in the multidisciplinary field "Soft Magnetic Composites".

III.B Advanced biocements: The modification of cement composition with zinc calcium silicate (hardystonite)/citric acid or calcium silicate components for bone filling applications showed significantly improved mechanical properties. Two kinds of material formulations for osteochondral or chondral defect treatment based on the study of the addition of amino acids to biocement mixtures as well as the preparation of acellular polyhydroxybutyrate/chitosan (PCH) composites were patented. The in vivo treatment of artificial osteochondral defects in knee of pigs with amino acid containing biocement clearly demonstrated good integration of the hyaline neocartilage with the surrounding tissue, as well as long-term stability and perfect interconnection between the neocartilage and new subchondral bone tissue, and such a positive result of application of bone cements for healing of these defect types was very seldom observed. Successfully healing artificially created knee cartilage defects in sheep model was also found after implantation of acellular PCH scaffolds supporting wound healing and formation of hyaline cartilage-like tissue which documents the use of scaffolds without the need for seeding and cultivate specific cell lines. The new fluoride toothpaste formulation with bioactive tetracalcium phosphate/monetite calcium phosphate mixture which effectively occluded dentin tubules and showed good dentin remineralization potential under de/remineralization cycling is another example of positive research impact on population health. Interesting for the first time published result was achieved in describing of novel setting process based on setting calcium phosphate cement as an inorganic mixture by an enzymatic process after mixing with active components.

III.C Biodegradable metallic systems: The preparation of biodegradable metallic materials based on iron powder was intensively studied, and their mechanical properties, corrosion processes and their biocompatibility were analyzed. Using applied mathematical models and subsequent experiments, materials made of pure iron, Fe-Mn alloy, composite formed by an iron matrix and particles of semiconducting metal oxides (ZnO, Fe2O3) dispersed in it, as well as systems coated with biopolymers or bioceramics were compared. Relevant data on mechanical properties and relationships between the course of corrosion and chemical and phase composition, microstructure and method of preparation of given materials were obtained. Model analyzes have shown that the conductive inert material in the metal matrix increases the corrosion potential of the sample and may or may not increase the corrosion current density depending on the ratio of oxygen reduction rate on the active and inert portions of the surface. The prepared biomaterial systems have the potential for use in hard tissue reconstruction medicine and scientific knowledge will help in optimizing the composition and preparation of metal systems, waste-free powder metallurgy technology.

III.D Electrocatalysts for future clean energy applications: The path to the future of energy is shifting from fossil fuels to renewables. Hydrogen as the product of water electrolysis is a flexible and clean energy carrier, since it not only offers the prospect of large green electricity storage capacities for weeks or months but also a broad spectrum of other options for industry decarbonization. NiCoP bimetallic phosphide nanoparticles incorporated into the carbon fibres (CF)

were evaluated as the most active materials within the investigated trinity NiCoP CF, FeNiP CF and FeCoP CF. The NiCoP CF catalyst provided low cell voltages in both acidic and alkali environment of 1.59 V and 1.71 V, respectively. The exceptional stability in acidic environment was proved. Bifunctional behaviour of NiCoP CF under harsh acid corrosion conditions is very rare and represents a breakthrough in the use of catalysts in PEM electrolysers. The added value of this contribution is preparation of this modified fibrous catalyst by simple and low-cost way using needle-less electrospinning technology. The catalytic material is prepared in the form of plates for direct use in fuel cells or electrolyzer membrane electrode assembly. Our study opens a novel platform for designing of noble-free advanced bifunctional electrocatalysts by in-situ modification with transition metal phosphides.

III.E Advanced transparent thin films: Transparent $LnNbO_4$ (LnNO) and $LnTaO_4$ (LnTO) thin films (~ 100 nm thickness) based on lanthanides Ln (Nd, Sm, Eu and Gd) were prepared by sol-gel/spin-coating method on Al_2O_3 substrates and annealing at 1000°C. In polymorphic films, the mechanism of phase transformation from fluorite phase through tetragonal to monoclinic was determined. Two valence states of Sm^{3+}/Sm^{2+} a Eu^{3+}/Eu^{2+} and one state of Nd^{3+} and Gd^{3+} at Nb^{5+} or Ta^{5+} ions were confirmed by X-ray photoelectron spectroscopy. Effect of substrate and microstructure of films on development of mechanical properties was confirmed by nanoindentation. Elastic modulus and hardness values were higher in LnTO films (~ 105.7 and 5.3 GPa) compared to values (~ 91.5 and ~ 3.8 GPa) in LnNO. The results of time-resolved luminescence spectra in films show that they can be used as sensors and imaging devices.

2. Partial indicators of main activities:

2.1. Research output

2.1.1. Principal types of research output of the institute: basic research/applied research, international/regional (in percentage)

Percentage of principal types of research output of the Institute:
basic research / applied research: 80/20
international research / regional research: 90/10

2.1.2 List of selected publications documenting the most important results of basic research. The total number of publications should not exceed the number of average FTE researchers per year. The principal research outputs (max. 10% of the total number of selected publications, including Digital Object Identifier – DOI if available) should be underlined. Authors from the evaluated organizations should be underlined.

1. VIOLA, Giusuppe** - TIAN, Ye - YU, Chuying - TAN, Yongqiang - KOVAĽ, Vladimír - WEI, Xiaoyong - CHOY, Kwang-Leong** - YAN, Haixue**. Electric field-induced transformations in bismuth sodium titanate-based materials. In *Progress in Materials Science*, 2021, vol. 122, p. 100837. (2020: **39.580 - IF**, Q1 - JCR, 9.172 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0079-6425. https://doi.org/10.1016/j.pmatsci.2021.100837

2. WU, Jiyue - ZHANG, Haibin - HUANG, Chang-Hsun - TSENG, Chiao-Wei - MENG, Nan - KOVAĽ, Vladimír - CHOU, Yi-Chia - ZHANG, Zhen** - YAN, Haixue**. Ultrahigh field-induced strain in lead-free ceramics. In *Nano Energy*, 2020, vol. 76, art. no. 105037. (2019: **16.602 - IF**, Q1 - JCR, 5.633 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 2211-2855. https://doi.org/10.1016/j.nanoen.2020.105037

3. YUE, Yajun - XU, Xinzhao - ZHANG, M. - YAN, Zhongna - KOVAĽ, Vladimír - WHITELEY, Richard M. - ZHANG, Dou - PALMA, Matteo - ABRAHAMS, Isaac** - YAN, Haixue**. Grain size effects in Mn-modified 0.67BiFeO3-0.33BaTiO3 ceramics. In *ACS Applied Materials & Interfaces*, 2021, vol. 13, p. 57548-57559. (2020: **9.229 - IF**, Q1 - JCR, 2.535 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 1944-8244. https://doi.org/10.1021/acsami.1c16083

4. SHEPA, Ivan** - MÚDRA, Erika - DUSZA, Ján. Electrospinning through the prism of time. In *Materials Today Chemistry*, 2021, vol. 21, art. no. 100543. (2020: **8.301 - IF**, Q1 - JCR, 1.521 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 2468-5194. https://doi.org/10.1016/j.mtchem.2021.100543

5. LI, Pengtao** - YANG, Y.Q. - KOVAĽ, Vladimír - CHEN, Jianxin - LUO, Xian - ZHANG, Wen - WANG, Bowen - YAN, Haixue. Temperature-dependent deformation processes in two-phase TiAl + Ti3Al nano-polycrystalline alloys. In *Materials and Design*, 2021, vol. 199, art. no. 109422. (2020: **7.991 - IF**, Q1 - JCR, 1.842 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0261-3069. https://doi.org/10.1016/j.matdes.2020.109422

6. WU, Jiyue - ZHANG, Hangfeng - MENG, Nan - KOVAĽ, Vladimír - MAHAJAN, Amit - GAO, Zhipeng - ZHANG, Dou** - YAN, Haixue**. Perovskite Bi0.5Na0.5TiO3-based materials for dielectric capacitors with ultrahigh thermal stability. In *Materials and Design*, 2021, vol. 198, art. no. 109344. (2020: **7.991 - IF**, Q1 - JCR, 1.842 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0261-3069. https://doi.org/10.1016/j.matdes.2020.109344

7. SAEIDI, Kamran - ZAPATA, Daniel Leon - LOFAJ, František - KVETKOVÁ, Lenka - OLSEN, Jon - SHEN, Zhijian - AKHTAR, Farid**. Ultra-high strength martensitic 420 stainless steel with high ductility. In *Additive Manufacturing*, 2019, vol. 29, p. 100803. (2018: **7.173 - IF**, Q1 - JCR, 2.591 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 2214-8604. https://doi.org/10.1016/j.addma.2019.100803

8. KOVAĽ, Vladimír** - SHI, Y. - ŠKORVÁNEK, Ivan - VIOLA, Giusuppe - BUREŠ, Radovan - SAKSL, Karel - ROUPCOVÁ, Pavla - ZHANG, M. - JIA, Chenglong - YAN, Haixue. Cobalt-induced structural modulation in multiferroic Aurivillius-phase oxides. In *Journal of Materials Chemistry C*, 2020, vol. 8, no. 25, p. 8466-8483. (2019: **7.059 - IF**, Q1 - JCR, 1.934 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 2050-7526. https://doi.org/10.1039/d0tc01443e

9. BRUNCKOVÁ, Helena** - MÚDRA, Erika - ROCHA, Lucas Alonso - NASSAR, Eduardo Jose - NASCIMENTO MELO, Willian Euripedes do - KOLEV, Hristo - KOVALČÍKOVÁ, Alexandra - MOLČANOVÁ, Zuzana - PODOBOVÁ, Mária - MEDVECKÝ, Ľubomír. Preparation and characterization of isostructural lanthanide Eu/Gd/Tb metal-organic framework thin films for luminiscent applications. In *Applied Surface Science*, 2021, vol. 542, art. no. 148731. (2020: **6.707 - IF**, Q1 - JCR, 1.295 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents, WOS, SCOPUS). ISSN 0169-4332. https://doi.org/10.1016/j.apsusc.2020.148731

10. WU, Jiyue - SUN, Wenfeng - MENG, Nan - ZHANG, Hangfeng - KOVAĽ, Vladimír - ZHANG, Yan - DONNAN, Robert - YANG, Bin - ZHANG, Dou - YAN, Haixue. Terahertz probing irreversible phase transitions related to polar clusters in Bi0.5Na0.5TiO3-based ferroelectric. In *Advanced Electronic Materials*, 2020, p. 1901373. (2019: **6.593 - IF**, Q1 - JCR, 2.454 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 2199-160X. https://doi.org/10.1002/aelm.201901373

11. CSANÁDI, Tamás - NÉMETH, Dušan - ZHANG, Chengyu - DUSZA, Ján. Nanoindentation derived elastic constants of carbon fibres and their nanostructural based predictions. In *Carbon*, 2017, vol. 119, p. 314-325. (2016: **6.337 - IF**, Q1 - JCR, 2.091 - SJR, Q1 - SJR, Current Contents - CCC). (2017 - Current Contents). ISSN 0008-6223. https://doi.org/10.1016/j.carbon.2017.04.048

12. BRUNCKOVÁ, Helena** - KOLEV, Hristo - ROCHA, Lucas Alonso - NASSAR, Eduardo Jose - MOSCARDINI, Susane Bonamin - MEDVECKÝ, Ľubomír. XPS characterization and luminescent properties of GdNbO4 and GdTaO4 thin films. In *Applied Surface Science*, 2020, vol. 504, p. 144358. (2019: **6.182 - IF**, Q1 - JCR, 1.230 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents, WOS, SCOPUS). ISSN 0169-4332. https://doi.org/10.1016/j.apsusc.2019.144358

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54. SAKSL, Karel** - MOLČANOVÁ, Zuzana - ĎURIŠIN, Juraj Jr. - JÓVÁRI, P. - MICHALIK, Štefan - TEMLEITNER, László - BALLÓKOVÁ, Beáta - GIRMAN, Vladimír - KATUNA, Yurij - ŠULÍKOVÁ, Michaela - ŠUĽOVÁ, Katarína - FEJERČÁK, Miloš - LISNICHUK, Maksym - LACHOVÁ, Adriana - KAPUSCINSKÝ, Lukáš. Atomic structure of Ca-Mg biodegradable metallic glass. In *Journal of Alloys and Compounds*, 2019, vol. 801, p. 651-657. (2018: **4.175 - IF**, Q1 - JCR, 1.065 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents, WOS, SCOPUS). ISSN 0925-8388. https://doi.org/10.1016/j.jallcom.2019.06.120

55. CSANÁDI, Tamás** - DUSZOVÁ, Annamária - DUSZA, Ján. Anisotropic slip activation via homogeneous dislocation nucleation in ZrB2 ceramic grains during nanoindentation. In *Scripta Materialia*, 2018, vol. 152, p. 89-93. (2017: **4.163 - IF**, Q1 - JCR, 1.923 - SJR, Q1 - SJR, Current Contents - CCC). (2018 - Current Contents). ISSN 1359-6462. https://doi.org/10.1016/j.scriptamat.2018.04.025

56. LOFAJ, František** - TANAKA, Hiroyoshi - BUREŠ, Radovan - SAWAE, Yoshinori - KABÁTOVÁ, Margita - FUKUDA, Kanao. The effect of humidity on friction behavior of hydrogenated HIPIMS W-C:H coatings. In *Surface & Coatings Technology*, 2021, vol. 428, p. 127899-1 - 127899-14. (2020: **4.158 - IF**, Q1 - JCR, 0.904 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0257-8972. https://doi.org/10.1016/j.surfcoat.2021.127899

57. CASTLE, Elinor** - CSANÁDI, Tamás - GRASSO, Salvatore - DUSZA, Ján - REECE, Michael J. Processing and properties of high-entropy ultra-high temperature carbides. In *Scientific Reports*, 2018, vol. 8, p. 8609-8619. (2017: **4.122 - IF**, Q1 - JCR, 1.533 - SJR, Q1 - SJR, Current Contents - CCC). (2018 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. https://doi.org/10.1038/s41598-018-26827-1

2.1.3 List of monographs/books published abroad

1. CENIGA, Ladislav**. Analytical models of coherent-interface-induced stresses in composite materials II. New York : Nova Science Publishers, 2021. 144 p. ISBN 978-1-68507-003-8
2. CENIGA, Ladislav**. Analytical models of coherent-interface-induced stresses in composite materials III. New York : Nova Science Publishers, 2021. 171 p. ISBN 978-1-53619-996-3
3. CENIGA, Ladislav**. Analytical models of coherent-interface-induced stresses in composite materials I. New York : Nova Science Publishers, 2020. 110 p. ISBN 978-1-53617-039-9
4. CENIGA, Ladislav. Analytical models of thermal and phase-transformation-induced stresses in materials with void defects II. New York : Nova Science Publishers, 2019. 262 p. ISBN 978-1-53614-982-1
5. CENIGA, Ladislav. Analytical models of thermal and phase-transformation- induced stresses in materials with void defects I. Nova Science Publishers, Inc., 2018. 185 p. ISBN 978-1-53613-526-8
6. CENIGA, Ladislav. Analytical models of thermal stresses in anisotropic composite materials. Hauppage, NY, USA : Nova Science Publishers, 2017. 216 p. ISBN 978-1-53611-064-7
7. CENIGA, Ladislav. Analytical models of hydrogen-induced stresses to materials I. Hauppage, NY, USA : Nova Science Publishers, 2017. 123 p. ISBN 978-53611-906-0

2.1.4. List of monographs/books published in Slovakia

2.1.5. List of other scientific outputs specifically important for the institute, max. 10 items for institute with less than 50 average FTE researchers per year, 20 for institutes with 50 – 100 average FTE researchers per year and so on

1. PETRUŠ, Ondrej** - MACKO, Ján - ORIŇAKOVÁ, Renáta - ORIŇAK, Andrej - MÚDRA, Erika - KUPKOVÁ, Miriam - FARKA, Zdeněk - PASTUCHA, Matěj - SOCHA, Vladimír. Detection of organic dyes by surface-enhanced Raman spectroscopy using plasmonic NiAg nanocavity films. In *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, 2021, vol. 249, art. no. 119322. (2020: **4.098 - IF**, Q1 - JCR, 0.606 - SJR, Q2 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 1386-1425. https://doi.org/10.1016/j.saa.2020.119322

2. CHENITI, Billel** - MIROUD, Djamel - BADJI, Riad - HVIZDOŠ, Pavol - FIDES, Martin - CSANÁDI, Tamás - BELKESSA, Brahim - TATA, Malik. Microstructure and mechanical behavior of dissimilar AISI 304L/WC-Co cermet rotary friction welds. In *Materials Science and Engineering A - Structural Materials Properties Microstructure and Processing*, 2019, vol. 758, p. 36-46. (2018: **4.081 - IF**, Q1 - JCR, 1.778 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 0921-5093. https://doi.org/10.1016/j.msea.2019.04.081

3. MEDVECKÝ, Ľubomír** - ŠTULAJTEROVÁ, Radoslava - GIRETOVÁ, Mária - MINČÍK, Jozef - VOJTKO, Marek - BALKO, Ján - BRIANČIN, Jaroslav. Effect of tetracalcium phosphate/monetite toothpaste on dentin remineralization and tubule occlusion in vitro. In *Dental Materials*, 2018, vol. 34, p. 442-451. (2017: **4.039 - IF**, Q1 - JCR, 2.106 - SJR, Q1 - SJR, Current Contents - CCC). (2018 - Current Contents). ISSN 0109-5641. https://doi.org/10.1016/j.dental.2017.11.022

4. BIESUZ, Mattia - SEDLÁK, Richard - SAUNDERS, Theo G. - KOVALČÍKOVÁ, Alexandra - DUSZA, Ján - REECE, Michael J. - ZHU, Degui - HU C, Chunfeng** - GRASSO, Salvatore**. Flash spark plasma sintering of 3YSZ. In *Journal of the European Ceramic Society*, 2019, vol. 39, p. 1932-1937. (2018: **4.029 - IF**, Q1 - JCR, 1.219 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 0955-2219. https://doi.org/10.1016/j.jeurceramsoc.2019.01.017

5. CAO, Jun - KOVAĽ, Vladimír - ZHANG, Hangfeng** - LIN, Yunyin - WU, Jiyue - MENG, Nan - LI, Yan - LI, Zheng** - ZHANG, Hongtao - YAN, Haixue. Crystal structure and electrical properties of textured Ba2Bi4Ti5O18 ceramics. In *Journal of the European Ceramic Society*, 2019, vol. 39, p. 1042-1049. (2018: **4.029 - IF**, Q1 - JCR, 1.219 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 0955-2219. https://doi.org/10.1016/j.jeurceramsoc.2018.12.017

6. CSANÁDI, Tamás** - CASTLE, Elinor - REECE, Michael J. - DUSZA, Ján. Strength enhancement and slip behaviour of high-entropy carbide grains during micro-compression. In *Scientific Reports*, 2019, vol. 9, p. 10200. (2018: **4.011 - IF**, Q1 - JCR, 1.414 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. https://doi.org/10.1038/s41598-019-46614-w

7. ABBAS, Aqeel** - HUANG, Song-Jeng - BALLÓKOVÁ, Beáta - SÜLLEIOVÁ, Katarína. Tribological effects of carbon nanotubes on magnesium alloy AZ31 and analyzing aging effects on CNTs/AZ31 composites fabricated by stir casting process. In Tribology International, 2020, vol. 142, p. 105982. (2019: **4.271 - IF**, Q1 - JCR, 1.536 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 0301-679X. https://doi.org/10.1016/j.triboint.2019.105982

8. BALEJČÍKOVÁ, Lucia** - SAKSL, Karel - KOVÁČ, J. - MARTEL, A. - GARAMUS, Vasil M.** - AVDEEV, Mikhail V. - PETRENKO, Viktor I. - ALMÁSY, L. - KOPČANSKÝ, Peter. The impact of redox, hydrolysis and dehydration chemistry on the structural and magnetic properties of magnetoferritin prepared in variable thermal conditions. In *Molecules*, 2021, vol. 26, no. 22, art. no. 6960. (2020: **4.412 - IF**, Q2 - JCR, 0.782 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents, WOS, SCOPUS). ISSN 1420-3049. https://doi.org/10.3390/molecules26226960

9. PETROVOVÁ, Eva** - TOMČO, Marek** - HOLOVSKÁ, Katarína - DANKO, Ján - KREŠÁKOVÁ, Lenka - VDOVIAKOVÁ, K. - SIMAIOVÁ, Veronika - KOLVEK, Filip - HORŇÁKOVÁ, Petra - TÓTH, T. - ŽIVČÁK, Jozef - GÁL, Peter - SEDMERA, David - LUPTAKOVA, Lenka - MEDVECKÝ, Ľubomír. PHB/CHIT scaffold as a promising biopolymer in the treatment of osteochondral defects - an experimental animal study. In *Polymers : Open Access Polymer Science Journal*, 2021, vol. 13, p. 1232-1 - 1232-26.

(2020: **4.329 - IF**, Q1 - JCR, 0.770 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 2073-4360. https://doi.org/10.3390/polym13081232

10. MEŽIBRICKÝ, Roland** - CSANÁDI, Tamás - VOJTKO, Marek - FRÖHLICHOVÁ, Mária - ABART, Rainer. Effect of alumina and silica content in the calcium aluminosilicoferrite Ca2(Ca,Fe,Mg)6(Fe,Si,Al)6O20 bonding phase on the strength of iron ore sinter. In Materials Chemistry and Physics, 2021, vol. 257, p. 123733. (2020: **4.094 - IF**, Q2 - JCR, 0.764 - SJR, Q2 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0254-0584. https://doi.org/10.1016/j.matchemphys.2020.123733

2.1.6. List of patents, patent applications, and other intellectual property rights registered abroad

2.1.7. List of patents, patent applications, and other intellectual property rights registered in Slovakia

2016:

Patent issued:
PV Number: 288348
The names of autors: Medvecký Ľubomír
Title of the invention: Kalcium fosfátová cementová prášková zmes a spôsob jej prípravy
Owner / co-owner: ÚMV SAV (IMR SAS)

PV Number: 288414
The names of autors: Kováč František, Petryshynets Ivan
Title of the invention: Zrnovo orientovaná elektrotechnická oceľ mikrolegovaná vanádom a spôsob jej výroby
Owner / co-owner: ÚMV SAV (IMR SAS)

Reported Invention:
PV Number: 00057-2016
The names of autors:Bureš Radovan, Fáberová Mária
Title of the invention: Spôsob mikrovlnného žíhania magneticky mäkkých práškov bez spekania
Owner / co-owner: ÚMV SAV (IMR SAS)

2017

Patent issued:
PV Number: PP120-2017
The names of autors: Medvecký Ľubomír, Giretová Mária, Štulajterová Radoslava, Danko J., Petrovová E.
Title of the invention: Biocementový systém na regeneráciu defektov chrupky
Owner / co-owner: ÚMV SAV (IMR SAS)

2018

Reported Invention
PV Number: PP101-2018
The names of autors: Ďurišinová Katarína, Szabó Juraj, Ďurišin Juraj, Saksl Karel, Milkovič Ondrej
Title of the invention: Spôsob prípravy nanokryštalickej práškovej zmesi Cu-Al2O3-MgO.
Owner / co-owner: ÚMV SAV (IMR SAS)

2019

Patent issued

PV Number: 288686
The names of autors: Bureš Radovan, Fáberová Mária
Title of the invention: Metóda žíhania magneticky mäkkých práškov bez spekania
Owner / co-owner: ÚMV SAV (IMR SAS)

PV Number: 288667
Title of the invention: Spôsob prípravy magnetických kompozitov s polymérnym elektroizolačným spojivom
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Bureš Radovan, Strečková Magdaléna, Fáberová Mária, Kollár Peter, Fuzer Ján

PV Number: 288701
Title of the invention: Spôsob prípravy vysokopevnej elektrotechnickej ocele s kompozitnou mikroštruktúrou
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Kováč František, Petryshynets Ivan

PV Number: 288715
Title of the invention: Biopolymérny kompozitný pórovitý systém na regeneráciu chrupky
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Medvecký Ľubomír, Giretová Mária, Petrovová Eva, MVDr., PhD.

Reported Invention

Title of the invention: Enzymaticky vytvrdzovaný biocoementový systém
PV Number: PP 26-2019
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Medvecký Ľubomír, Giretová Mária, Štulajterová Radoslava

2020:

Patents issued

Title of the invention: Vysokopevná izotropná elektrotechnická oceľ s kompozitnou mikroštruktúrou
PV Number: 288760
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Kováč František, Petryshynets Ivan

Title of the invention: Spôsob prípravy nanokryštalickej práškovej zmesy Cu-Al2O3 - MgO
PV Number: 288815
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Ďurišinová Katarína, Szabó Juraj, Ďurišin Juraj, Saksl Karel, Milkovič Ondrej

Title of the invention: Biocementový systém na regeneráciu defektov chrupky
PV Number: 288818
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Medvecký Ľubomír, Giretová Mária, Štulajterová Radoslava, Danko J., Petrovová E.

2021

Reported Invention

Title of the invention: Spôsob prípravy práškovej biocementovej kalcium fosfátovej zmesi.
PV Number: PP 11-2021
Owner / co-owner: ÚMV SAV (IMR SAS)

The names of autors: Medvecký Ľubomír, Giretová Mária, Štulajterová Radoslava

Title of the invention: Spôsob valcovania rozvalku vysokopevnej elektrotechnickej ocele na teplej širokopásovej trati
PV Number: PP 78-2021
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Kováč František, Petryshynets Ivan

Title of the invention: Spôsob výroby kompozitných magnetických práškov autonómnym mletím
PV Number: PP 13-2021
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Bureš Radovan, Fáberová Mária

Title of the invention: Spôsob úpravy povrchu tvarových dielov foriem a jadier na liatie zliatin hliníka
PV Number: SK 140-2020
Owner / co-owner: ÚMV SAV (IMR SAS)
The names of autors: Džupon Miroslav, Petryshynets Ivan, Brezinova Janette

2.1.8. Narrative on the most important research outputs of the institute – especially focused on their importance for society (3-5 pages)

1) Biodegradable alloys

The research and development of biodegradable alloys at the IMR began in 2014, helped by the establishment of laboratories of "Progressive Alloys" and "Thermal Analysis of Materials" from European Union funds (Promatech project). The research began with an open call to an international community of scientists at DESY Hamburg, Wigner Budapest, IFW Dresden to participate in the research of calcium-based metallic glasses. The area of preparation and evaluation of properties of Ca-metal glasses was coordinated by IMR SAS and developed into several joint cooperation and measurement projects on synchrotron sources (DESY Hamburg, ESRF Grenoble and Diamond Light Source UK) as well as neutron sources (BNC Budapest, JINR April Russia). In 2016, this research was expanded to include Mg-alloys and in 2020 also to Zn alloys. The great stimulus for our research was the cooperation with the Faculty of Mechanical Engineering TUKE, which is a customer of materials for the field of 3D printing of personalized intra-body implants. Another stimulus is the relatively recent cooperation with the company AMAZEMET in Poland, which is unique in its approach to the atomization of metal alloys. Our common goal in the future is to create a robotic workplace in which the input elements will be metal elements together with the know-how of suitable alloys and through technological nodes of powder production, 3D printing at its output will be intracranial implants tailored to the patient and his injuries, which will provide mechanical support only. for the time needed for its regeneration, after which they will completely dissolve in the form of nutrients that support the healing of the surrounding tissue. On this topic. three dissertations, one habilitation thesis and two university textbooks were published. Among our most significant results in this area we include:

1. Saksl, K., et al. (2021) Journal of Non-Crystalline Solids, 558, art. no. 120660, .
2. Šuliková, M., et al. (2020) International Journal of Nanotechnology, 17 (7-10), pp. 573-582.
3. Saksl, K. et al. (2019) Journal of Alloys and Compounds, 801, pp. 651-657.
4. Molčanová, Z. et al. Development of new biodegradable alloys for medical applications (2019) METAL 2019 - 28th International Conference on Metallurgy and Materials, Conference Proceedings, pp. 1204-1209.
5. Saksl, K., et al. (2017) Journal of Alloys and Compounds, 725, pp. 916-922.
6. Michalik, Š. et al. (2016) Journal of Alloys and Compounds, 687, pp. 188-196.

2) Electric steels for electric cars and hybrid engines

An original concept of composite microstructural and substructural design of non-oriented high-strength electrical steel was developed / patent no. 288760 / and a technological procedure was designed to achieve the required microstructural and textural structure in isotron electrotechnical sheets / patent no. 288701 /. The concept is based on a composite arrangement of microstructure and substructure along the thickness of the sheet, while the subsurface area formed by fine, dispersion-strengthened ferritic grain has primarily high strength properties and the coarse-grained ferritic microstructure in the central region ensures good electromagnetic properties. Layer thickness is optional. The composite microstructure provides a combination of strength and excellent electromagnetic properties, with good resistance to dynamic fatigue of the material. Such a combination of steel properties will allow its application to the construction of rotor cores for electric cars and hybrid drives and to electric motors operating at high speeds and with sharp changes in speed causing high centrifugal forces.

1. Kováč, F. , et al. Archives of Metallurgy and Materials, 2017, vol. 62, no. 3, p. 1727-1732.
2. Petryshynets, I., et al. AIP Advances, 2018, vol. 8, iss. 4, art. no. 047604.
3. Petryshynets, I., et al. Materials, 2019, vol. 12, p. 2200.
4. Petryshynets, I., et al. Materials, 2019, vol. 12, p. 1914.
5. Petryshynets, I., et al. Materials, 2021, vol. 14, p. 7124-1 - 7124-16.

3) Gradient materials for engineering applications

Numerical, visualization and simulation methods as well as complex material analyzes using light and electron microscopy techniques were used to analyze the wear of working tools and components of forest technology. The demand for dealing with intensive wear of working tools and components came directly from practice. These are mainly working tools of forest cutters (crusher of unwanted growths, mulcher, soil cutter, road cutter). Technical solutions for increasing the technological service life of elements of selected machines used in forestry were developed. The best results were achieved with hard welding electrode E 520 RB and surface treatment of the welded surface by grooving. The partial results:

1. Utility model no. 9285, "Džupon, M., Hnilica, R., Ťavodová, M., Hnilicová, M., Petryshynets, I. Mechanical grooving of functional parts of working tools";
2. Falat, L.; et al. *Materials* **2019**, *12*, 2212.

4) Ceramic composite materials with carbon structures

The scientific team led by prof. Ján Dusza, has been actively cooperating in top research in the field of ceramic composite materials with carbon structures for more than ten years. It combines knowledge in the field throughout the Slovak Republic. They carried out research into the development of new modern ceramics with the aim of increasing its mechanical, tribological and functional properties. They achieved excellent results in the research of ceramics based on nitrides, borides and carbides with the addition of graphene structures as well as the creation of promising layered systems. The team, in mutual cooperation and in cooperation with other foreign partners among the first in the world (in 2010 to 2012) carried out research and published results in the field of increasing the toughness and tribological properties of Si3N4 + graphene ceramics. In the years 2015 - 2017, the team continued the research, developed and characterized new systems such as SiC + graphene and B4C + graphene. In recent years, the collaborating team has focused on the development of new layered ceramic + graphene systems with exceptional tribological properties.
The most important results in this area include:

1. Múdra, E., et al. Wear, (2021) 484-485, art. no. 204026.
2. Hanzel, O., et al. Materials, (2021) 14 (11), art. no. 2916.
3. Liao, Z., et al. Nanomaterials, (2021) 11 (2), art. no. 285, pp. 1-13.
4. Li, M., et al. Ceramics (2021) International.
5. Kovalčíková, A., et al. Journal of the European Ceramic Society, (2020) 40 (14), pp. 4860-4871.
6. Puchý, V. et al. Journal of the European Ceramic Society, (2020) 40 (14), pp. 4853-4859.
7. Múdra, E., et al. Journal of the European Ceramic Society, (2020) 40 (14), pp. 4808-4817.
8. Balázsi, K., et al. Journal of the European Ceramic Society, (2020) 40 (14), pp. 4792-4798.
9. Balázsi, K., et al. Journal of Alloys and Compounds, (2020) 832, art. no. 154984.
10. Tapasztó, O., et al. Ceramics International, (2019) 45 (6), pp. 6858-6862.
11. Zhang, W., et al. Tribology Letters, (2018) 66 (4), art. no. 121.
12. Tapasztó, O., et al. Scientific Reports, (2017) 7 (1), art. no. 10087.
13. Sedlák, R., et al. Journal of the European Ceramic Society, (2017) 37 (14), pp. 4307-4314.
14. Sedlák, R., et al. Journal of the European Ceramic Society, (2017) 37 (12), pp. 3773-3780.
15. Hanzel, O., et al. Journal of the European Ceramic Society, (2017) 37 (12), pp. 3731-3739.
16. Balázsi, C., et al. Journal of the European Ceramic Society, (2017) 37 (12), pp. 3797-3804.
17. Sedlák, R., et al. Intl. Journal of Refractory Metals and Hard Materials, (2017) 65, pp. 57-63.
18. Sedlák, R., et al. Defect and Diffusion Forum, (2016) 368, pp. 166-169.
19. Kovalčíková, A., et al. Ceramics International, (2016) 42 (1), pp. 2094-2098.
20. Tapasztó, O., et al. Ceramics International, (2016) 42 (1), pp. 1002-1006.

5) Research of hard thin coatings

The importance of research work in the field of hard thin coatings lies in the need to meet the ever-increasing demands on the life and durability of mechanical components, especially in demanding working conditions, e.g. in a highly corrosive environment, vacuum, at high or ultra-low operating temperatures, etc. while maintaining high efficiency and increased demands on the environmental burden. The latest direction is the use of new technologies and multi-component systems stabilized

by configuration entropy, which is in line with the global trend of increasing the thermal stability of coatings.

1. Bilanych, V.S. et al. Thin Solid Films, 2016, vol. 616, p. 86-94.
2. Lofaj, F. et al. Journal of the European Ceramic Society, 2016, vol. 36, p. 3029-3040.
3. Csanádi, T. et al. Experimental Mechanics, 2017, vol. 57, p. 1057-1069.
4. Lofaj, F. - Németh, D. Thin Solid Films, 2017, vol. 644, p. 173-181.
5. Lofaj, F. - NÉMETH, D. Journal of the European Ceramic Society, 2017, vol. 37, p. 4379-4388
6. Lofaj, F. et al. Surface and coatings technology, 2019, vol. 375, p. 839-853
7. Lofaj, F. et al. Intl Journal of Refractory Metals and Hard Materials, 2019, vol. 80, p. 305-314
8. Lofaj, F. et al. Ceramics International, 2019, vol. 45, p. 9502-9514
9. Lofaj, F. et al. International Journal of Refractory Metals and Hard Materials, 2020, vol. 88, p. 105211
10. Lofaj, F. et al. Journal of the European Ceramic Society, 2020, vol. 40, p. 2721-2730
11. Kvetková, L. et al. Metallurgical Research and Technology, 2021, vol. 118, p. 210
12. Lofaj, F. et al. Wear 2021, vol. 486-487, 204123
13. Lofaj, F. et al. Surface and Coatings Technology, 2021, vol. 428, p. 127899-1 - 127899-14

6) Development of nanofibers

The introduction of a new technology of electrostatic spinning from the free surface of a polymer solution started at the IPR SAS in 2015. This technology enables the development of polymer and composite fibers using the Nanospider device. At the same time, using the technology in combination with subsequent heat treatment, it was possible to prepare ceramic fiber nanosystems based on oxides such as CuO, ZnO, Fe2O3, TiO2, SnO2, Al2O3, La1 / 3TaO3 from precursor solutions and also to produce carbon nanofibers, even at the semi-industrial level with higher productivity. To date, we have considerable experience with the development of carbon fibers doped with various nanoparticles based on nickel, copper, cobalt, titanium usable as an electrode material in the production of hydrogen from aqueous solutions, as well as new materials for battery applications. Research has also developed here in the field of the production of textiles doped with nanoparticles, e.g. silver and easy formation of polymeric nano / microfiber layers with controlled fiber thickness and the layers themselves usable in the field of filters. Research into the development of ceramic fibers based on titanium and tin has moved towards applications in the field of gas sensors, solar cells and materials suitable for photocatalysis. Aluminum oxide fibers have been applied as fillers in new composite materials and have significantly improved their tribological and mechanical properties such as toughness.
The most important results in this area include:

1.Múdra, E., et al. Journal of Sol-Gel Science and Technology, 78, 2016, s.322-330.
2. Strečková, M., et al. Acta Physica Polonica A, 131, 2017, s.729-731.
3. Múdra, E., et al. Applied Surface Science, 415, 2017, s.90-98.
4. Shepa, I., et al. Ceramics International, 44, 2018, s.17925-17934.
5. Múdra, E., et al. Applied Surface Science, 480, 2019, s.876-881.
6. Shepa, I., et al. Results in Physics, 13, 2019, s.102243.
7. Hajdová, P., et al. Acta Physica Polonica A, 137, 2020, s.800-802.
8. Shepa, I., et al. Applied Surface Science, 523, 2020, s.146381.
9. Múdra, E., et al. Journal of the European Ceramic Society, 40, 2020, s.4808-4817.
10. Velgosová, O., et al. Bulletin of Materials Science, 44, 2021, s.47.
11. Shepa, I., Múdra, E., Dusza, J.: Materials Today Chemistry, 21, 2021, s.100543.
12. Velgosová, O., Múdra, E., Vojtko, M.: Polymers, 13, 2021, s.605.
13. Múdra, E., et al. Wear, 484-485, 2021, s.204026.
14. Štelmáková, M., et al. Chemical Papers, 76, 2022, s.855-867.

7) Magnetically soft composites

The growing interest in magnetically soft composite materials is related to their application in the field of energy conversion. Increasing the working frequency of materials allows you to miniaturize parts and increase conversion efficiency. The results of research in the field of powder magnetic materials published in major scientific journals and presented at domestic and international conferences serve as a starting point for further basic and applied research in research and

development institutions around the world. The published works describe new and innovative methods in the preparation of composite materials, the characteristics of their functional, especially magnetic and electrical properties in order to enable the development of materials according to the specific requirements of practice, especially in electronics and electrical engineering. The results of the research of powder composites were applied in 2 granted national patents, 1 patent application, led to the acquisition of 4 contract research projects with foreign industrial partners (Würth, HUAMAG, 2 HUACON contracts). In cooperation with partner universities, the solution of the issue directly helped the education of students - future professionals at all levels of education, especially doctoral level.

1. Birčáková, Z. et al. Journal of Alloys and Compounds, 2020, vol. 828, p. 154416.
2. Birčáková, Z. et al. Journal of Magnetism and Magnetic Materials, 2019, vol. 485, p. 1-7.
3. Füzer, J. et al. Journal of Alloys and Compounds, 2018, vol. 753, p. 219-227.
4. Dobák, S. et al. Journal of Magnetism and Magnetic Materials, 2017, vol. 426, p. 320-327.
5. Lauda, M. et al. Journal of Magnetism and Magnetic Materials, 2016, vol. 411, p. 12-17.

8) Materials for substitution of bones and cartilage

Degeneration and damage to cartilage, or even subchondral bone, due to primary (mainly genetic, in the absence of a predisposing trauma or disease), as well as secondary factors (e.g., metabolic, inflammatory, post-traumatic) are in fact a significant social problem; e.g., osteoarthritis affects about 40 million people in Europe. In medical practice, several surgical procedures are applied to treat articular cartilage or subchondral defects and all the methods used have specific drawbacks, which include, e.g., tissue formation with different properties than the original tissue, the need to open another operating field for harvesting of healthy tissue with its possible death at the donor site, the need to cultivate specific cells, the possibility of transmitting various diseases between donor and patient etc. The developed patented amino acids/calcium phosphate biocement mixtures (patent no. 288818) were applied in vivo using the simple surgery procedure based on deeper drilling to subchondral bone, in combination with a pasty consistency of cements, allows massive bone-marrow flow with a complex composition of cells, growth factors and cytokines , as well as mesenchymal stem-cell migration from bone cavity to artificial defect (1). Treatment of the defect site by this procedure eliminated the utilization of additional invasive procedures connected with autologous harvesting of MSCs or chondrocytes from patients and their long-term cultivation in the next step.The measured material characteristics of biocements likely supported, positively, the proper formation of hyaline cartilage and subchondral bone defect healing in animal model and results in preclinical stage allows to start testing materials in human medicine.
In medical practice, several surgical procedures are applied to treat articular cartilage or subchondral defects and all the methods used have specific drawbacks, which include, e.g., tissue formation with different properties than the original tissue, the need to open another operating field for harvesting of healthy tissue with its possible death at the donor site, the need to cultivate specific cells, the possibility of transmitting various diseases between donor and patient etc. The developed patented amino acids/calcium phosphate biocement mixtures were applied in vivo using the simple surgery procedure based on deeper drilling to subchondral bone, in combination with a pasty consistency of cements, allows massive bone-marrow flow with a complex composition of cells, growth factors and cytokines , as well as mesenchymal stem-cell migration from bone cavity to artificial defect. Treatment of the defect site by this procedure eliminated the utilization of additional invasive procedures connected with autologous harvesting of MSCs or chondrocytes from patients and their long-term cultivation in the next step.The measured material characteristics of biocements likely supported, positively, the proper formation of hyaline cartilage and subchondral bone defect healing in animal model and results in preclinical stage allows to start testing materials in human medicine.

1. Medvecky, L. et al. Materials 2021, 14, 436.

9. Materials for biodegradable metallic impants

In medical practice, metal implants commonly provide mechanical support to treated hard body tissues. The active help of implants is often needed only temporarily, later their presence can trigger adverse reactions. The solution is metal implants that can break down, absorb and eliminate the body over time. Preferred material systems could be low toxic Fe-based materials

provided the corrosion rate control can be controlled. From the point of view of the practical use of these materials for medical purposes, the corrosion processes of various composite systems have been thoroughly studied. In Hanks' solution, the metal oxide samples had a corrosion potential about 0.4 V higher and corroded about an order of magnitude faster than the pure Fe samples, indicating "bimetallic" corrosion with an iron anode and oxide cathode, i.e. the effect of the volume content of iron oxides. on the corrosion rate. The phosphate coating slowed the rate of sample degradation by about one-fifth by limiting the supply of oxygen to the sites where it was reduced. Thus, changes in the thickness and porosity of the coating can lead to changes in the corrosion rate of the substrate material. Phosphating followed by calcination in air increased the mechanical stiffness of the samples by more than 1.6 times by forming a cohesive glassy surface layer containing various phases of the Fe-P-O system.

1. Hrubovčáková M. et al. Advances in Materials Science and Engineering, 2016, art. ID 6257368.
2. Kupková M. et al. International Journal of Electrochemical Science, 2017, vol. 12, p. 3120-3132.
3. Kupková M. et al. Int. Journal of Electrochemical Science, 2018, vol. 13, p. 11839-11852.
4. Oriňaková, R. et al. Applied Surface Science, 2020, vol. 505, p. 144634.
5. Kupková M. et al. Defect and Diffusion Forum, 2020, vol. 405, p. 411-416.

10. Electrocatalysts for green hydrogen production

Hydrogen as the product of water electrolysis using renewable electricity represents a flexible and clean energy carrier. However, currently only 4% of globally produced hydrogen originates from electrolysis sources. It is mainly due to the economic issues. A promising way how to increase competitiveness of this technology represents enhancement of the both, hydrogen evolution (HER), as well as oxygen evolution (OER) reaction by means of a suitable electrocatalysts. Today, platinum group metals such as Pt, RuO_2 and IrO_2 are considered as the state of the art electrocatalysts. Due to their scarcity and related high price, the scientific community around the globe strives to find an adequate alternative from the family of non-noble metals while maintaining all exceptional electrochemical properties and excellent stability. At IMS SAS was developed new materials based on transition metal phosphides incorporated into the carbon fibrous matrix as a potential noble metal free electrocatalysts for membrane water electrolysis.

1. Hečková, M. et al. Applied Surface Science, 2020, vol. 506, p. 144955.
2. Strečková M. et al. Applied Surface Science, 2020, vol. 507, p. 144927.
3. Strečková M. et al. Applied Surface Science, 2019, vol. 479, p. 70-76.
4. Strečková M. et al. Energy Technology, 2018, vol. 6, p. 1310-1331.
5. Strečková M. et al. Chemical Engineering Journal, 2016, vol. 303, p. 167-181.

11) Thin nanocrystalline films for environmental electrolytic devices, phosphors and sensors

Thin film lanthanide thin films (Ln = La, Nd, Sm, Eu and Gd) were successfully prepared by the sol-gel synthesis method. The developed translucent nanocrystalline LnNbO4 and LnTaO4 films with a thickness of ~100 nm were prepared on Al2O3 and Si substrates and the measured results showed excellent physical, mechanical and luminescent properties. The specific synthesis helps to create different polymorphs in these films with possible application as solid electrolytes for environmental electrolytic equipment in fuel cells. Another area of research was the development of sol-thermal synthesis and characterization of porous metal-organic networks (Ln-MOFov) based on lanthanides (Ln = Eu, Gd and Tb) and their films in mixed hybrid systems so that red-emitting phosphors (Eu3 +), green (Tb3 +) and blue (Gd3 +) light were incorporated into the resulting RGB (red, green, blue) structure capable of generating white light. Luminescent isostructured EuxTbyGdz-MOF films on Pt / SiO2 / Si substrates were prepared to expand their potential use in luminescent sensors and LED applications.

1. Brunckova, H. et al. Applied Surface Science, 2021, vol. 542, art. no. 148731.
2. Brunckova, H. et al. Applied Surface Science, 2020, vol. 504, p. 144358.
3. Brunckova, H. et al. Applied Surface Science, 2019, vol. 473, p. 1-5.
4. Brunckova, H. et al. Materials and Design, 2017, vol. 134, p. 455-468.
5. Brunckova, H. et al. Journal of Alloys and Compounds, 2018, vol. 735, p. 1111-1118.

2.1.9. Table of research outputs

Papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) have to be listed separately

Scientific publications	2016			2017			2018			2019			2020			2021			total			
	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. /1 million total salary budget	number	averaged number per year	av. No. / FTE researches	av. No. / one million total salary budget
Scientific monographs and monographic studies in journals and proceedings published abroad *(AAA, ABA)*	0	0,000	0,000	2	0,045	1,770	1	0,021	0,802	1	0,021	0,621	1	0,019	0,563	2	0,036	0,991	**7**	**1,167**	**0,024**	**0,796**
Scientific monographs and monographic studies in journals and proceedings published in Slovakia *(AAB, ABB)*	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	**0**	**0,000**	**0,000**	**0,000**
Chapters in scientific monographs published abroad *(ABC)*	3	0,068	2,970	1	0,023	0,885	**0**	0,000	0,000	0	0,000	0,000	0	0,000	0,000	3	0,054	1,487	**7**	**1,167**	**0,024**	**0,796**
Chapters in scientific monographs published in Slovakia *(ABD)*	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	**0**	**0,000**	**0,000**	**0,000**
Scientific papers published in journals registered in Current Contents Connect *(ADCA, ADCB, ADDA, ADDB)*	43	0,974	42,563	74	1,674	65,478	49	1,049	39,275	57	1,204	35,375	86	1,660	48,399	72	1,303	35,685	**381**	**63,500**	**1,316**	**43,325**
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS not listed above *(ADMA, ADMB, ADNA, ADNB)*	18	0,408	17,817	18	0,407	15,927	14	0,300	11,221	14	0,296	8,689	28	0,540	15,758	5	0,091	2,478	**97**	**16,167**	**0,335**	**11,030**
Scientific papers published in other foreign journals (not listed above) *(ADEA, ADEB)*	2	0,045	1,980	3	0,068	2,655	7	0,150	5,611	2	0,042	1,241	1	0,019	0,563	1	0,018	0,496	**16**	**2,667**	**0,055**	**1,819**
Scientific papers published in other domestic journals (not listed above) *(ADFA, ADFB)*	5	0,113	4,949	7	0,158	6,194	2	0,043	1,603	2	0,042	1,241	0	0,000	0,000	2	0,036	0,991	**18**	**3,000**	**0,062**	**2,047**
Scientific papers published in foreign peer-reviewed proceedings *(AECA)*	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	1	0,021	0,621	0	0,000	0,000	0	0,000	0,000	**1**	**0,167**	**0,003**	**0,114**
Scientific papers published in domestic peer-reviewed proceedings *(AEDA)*	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	**0**	**0,000**	**0,000**	**0,000**
Published papers (full text) from foreign scientific conferences *(AFA, AFC)*	10	0,226	9,898	4	0,090	3,539	3	0,064	2,405	0	0,000	0,000	1	0,019	0,563	0	0,000	0,000	**18**	**3,000**	**0,062**	**2,047**
Published papers (full text) from domestic scientific conferences *(AFB, AFD)*	2	0,045	1,980	14	0,317	12,388	12	0,257	9,618	15	0,317	9,309	4	0,077	2,251	5	0	2	**52**	**9**	**0**	**6**

2.2. Measures of research outputs (citations, etc.)

2.2.1. Table with citations per annum (without self-citations)

Citations of papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) are listed separately

Citations, reviews	2015		2016		2017		2018		2019		2020		total		
	number	No. / FTE researchers	number	No. / FTE researchers	number	No. / FTE researchers	number	No. / FTE researchers	number	No. / FTE researchers	number	No. / FTE researchers	number	averaged number per year	av. No. / FTE researchers
Citations in Web of Science Core Collection (1.1, 2.1)	501	11,35	572	12,94	734	15,72	879	18,56	1 136	21,93	1 352	24,48	**5 174**	**862,33**	**17,87**
Citations in SCOPUS (1.2, 2.2) if not listed above	96	2,17	110	2,49	89	1,91	101	2,13	99	1,91	98	1,77	**593**	**98,83**	**2,05**
Citations in other citation indexes and databases (not listed above) (3.2,4.2)	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	**0**	**0,00**	**0,00**
Other citations (not listed above) (3.1, 4.1)	20	0,45	13	0,29	18	0,39	8	0,17	9	0,17	2	0,04	**70**	**11,67**	**0,24**
Reviews (5,6)	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	0	0,00	**0**	**0,00**	**0,00**

2.2.2. List of 10 most-cited publications published any time with the address of the institute, with number of citations in the assessment period (2015 – 2020)

1. TAN, Yongqiang - ZHANG, Jialiang - WU, Yanqing - WANG, Chunlei - KOVAĽ, Vladimír - SHI, Baogui - YE, Haitao - MCKINNON, Ruth - VIOLA, Giusuppe - YAN, Haixue. Unfolding grain size effects in barium titanate ferroelectric ceramics. In Scientific Reports, 2015, vol. 5, 9953. (2014: 5.578 - IF, Q1 - JCR, 2.163 - SJR, Q1 - SJR, karentované - CCC). (2015 - Current Contents, Scopus, WOS). ISSN 2045-2322. https://doi.org/10.1038/srep09953 **137 citations**
2. KVETKOVÁ, Lenka - DUSZOVÁ, Annamária - HVIZDOŠ, Pavol - DUSZA, Ján - KUN, Péter - BALÁZSI, Csaba. Fracture toughness and toughening mechanisms in graphene platelet reinforced Si3N4 composites. In Scripta Materialia, 2012, vol. 66, p. 793-796. (2011: 2.699 - IF, Q1 - JCR, 2.314 - SJR, Q1 - SJR, karentované - CCC). (2012 - Current Contents). ISSN 1359-6462.: https://doi.org/10.1016/j.scriptamat.2012.02.009 **106 citations**
3. DUSZA, Ján - MORGIEL, Jerzy - DUSZOVÁ, Annamária - KVETKOVÁ, Lenka - NOSKO, Martin - KUN, Péter - BALÁZSI, Csaba. Microstructure and fracture toughness of Si3N4+graphene platelet composites. In Journal of the European Ceramic Society, 2012, vol. 32, p. 3389-3397. (2011: 2.353 - IF, Q1 - JCR, 1.343 - SJR, Q1 - SJR, karentované - CCC). (2012 - Current Contents, WOS, SCOPUS). ISSN 0955-2219. https://doi.org/10.1016/j.jeurceramsoc.2012.04.022 **101 citations**
4. CASTLE, Elinor** - CSANÁDI, Tamás - GRASSO, Salvatore - DUSZA, Ján - REECE, Michael J. Processing and properties of high-entropy ultra-high temperature carbides. In Scientific Reports, 2018, vol. 8, p. 8609-8619. (2017: 4.122 - IF, Q1 - JCR, 1.533 - SJR, Q1 - SJR, karentované - CCC). (2018 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. https://doi.org/10.1038/s41598-018-26827-1 **99 citations**
5. VIOLA, Giusuppe - MCKINNON, Ruth - KOVAĽ, Vladimír - ADOMKEVICIUS, Arturas - DUNN, Steve - YAN, Haixue. Lithium-induced phase transitions in lead-free Bi0.5Na0.5TiO3 based ceramics. In Journal of Physical Chemistry C, 2014, vol. 118, p. 8564-8570. (2013: 4.835 - IF, Q1 - JCR, 2.134 - SJR, karentované - CCC). (2014 - Current Contents, WOS, SCOPUS). ISSN 1932-7447. https://doi.org/10.1021/jp500609h **98 citations**
6. SAEIDI, Kamran - GAO, X. - LOFAJ, František - KVETKOVÁ, Lenka - SHEN, Zhijian. Transformation of austenite to duplex austenite-ferrite assembly in annealed stainless steel 316L consolidated by laser melting. In Journal of Alloys and Compounds, 2015, vol. 633, p. 463-469. (2014: 2.999 - IF, Q1 - JCR, 1.117 - SJR, Q1 - SJR, karentované - CCC). (2015 - Current Contents, WOS, SCOPUS). ISSN 0925-8388. https://doi.org/10.1016/j.jallcom.2015.01.249 **81 citations**
7. KOLLÁR, P. - BIRČÁKOVÁ, Zuzana - FÜZER, J. - BUREŠ, Radovan - FÁBEROVÁ, Mária. Power loss separation in Fe-based composite materials. In Journal of Magnetism and Magnetic Materials, 2013, vol. 327, p. 146-150. (2012: 1.826 - IF, Q2 - JCR, 0.928 - SJR, Q1 - SJR, karentované - CCC). (2013 - Current Contents, WOS, SCOPUS). ISSN 0304-8853. https://doi.org/10.1016/j.jmmm.2012.09.055 **69 citations**
8. HVIZDOŠ, Pavol - DUSZA, Ján - BALÁZSI, Csaba. Tribological properties of Si3N4-graphene nanocomposites. In Journal of the European Ceramic Society, 2013, vol. 33, p. 2359-2364. (2012: 2.360 - IF, Q1 - JCR, 1.293 - SJR, Q1 - SJR, karentované - CCC). (2013 - Current Contents, WOS, SCOPUS). ISSN 0955-2219. https://doi.org/10.1016/j.jeurceramsoc.2013.03.035 **68 citations**
9. QIAN, B. - SAEIDI, Kamran - KVETKOVÁ, Lenka - LOFAJ, František - XIAO, C. - SHEN, Zhijian. Defects-tolerant Co-Cr-Mo dental alloys prepared by selective laser melting. In Dental Materials, 2015, vol. 31, p. 1435-1444. (2014: 3.769 - IF, Q1 -

JCR, 2.250 - SJR, Q1 - SJR, karentované - CCC). (2015 - Current Contents). ISSN 0109-5641. https://doi.org/10.1016/j.dental.2015.09.003 **58 citations**

10. NAGLER, Bob - SAKSL, Karel. Turning solid aluminium transparent by intense soft X-ray photoionization. In Nature Physics, 2009, vol. 5, p. 693-696. (2008: 16.821 - IF, Q1 - JCR, 10.103 - SJR, Q1 - SJR, karentované - CCC). (2009 - Current Contents). ISSN 1745-2473. https://doi.org/10.1038/NPHYS1341 **56 citations**

2.2.3. List of 10 most-cited publications published any time with the address of the institute, with number of citations obtained until 2020

1. KVETKOVÁ, Lenka - DUSZOVÁ, Annamária - HVIZDOŠ, Pavol - DUSZA, Ján - KUN, Péter - BALÁZSI, Csaba. Fracture toughness and toughening mechanisms in graphene platelet reinforced Si3N4 composites. In Scripta Materialia, 2012, vol. 66, p. 793-796. (2011: 2.699 - IF, Q1 - JCR, 2.314 - SJR, Q1 - SJR, Current Contents - CCC). (2012 - Current Contents). ISSN 1359-6462. https://doi.org/10.1016/j.scriptamat.2012.02.009 **140 citations**
2. TAN, Yongqiang - ZHANG, Jialiang - WU, Yanqing - WANG, Chunlei - KOVAĽ, Vladimír - SHI, Baogui - YE, Haitao - MCKINNON, Ruth - VIOLA, Giusuppe - YAN, Haixue. Unfolding grain size effects in barium titanate ferroelectric ceramics. In Scientific Reports, 2015, vol. 5, 9953. (2014: 5.578 - IF, Q1 - JCR, 2.163 - SJR, Q1 - SJR, Current Contents - CCC). (2015 - Current Contents, Scopus, WOS). ISSN 2045-2322. https://doi.org/10.1038/srep09953 **137 citations**
3. NAGLER, Bob - SAKSL, Karel. Turning solid aluminium transparent by intense soft X-ray photoionization. In Nature Physics, 2009, vol. 5, p. 693-696. (2008: 16.821 - IF, Q1 - JCR, 10.103 - SJR, Q1 - SJR, Current Contents - CCC). (2009 - Current Contents). ISSN 1745-2473. https://doi.org/10.1038/NPHYS1341 **134 citations**
4. ŠAJGALÍK, Pavol - DUSZA, Ján - HOFFMANN, M.J. Relationship between microstructure toughening mechanisms and fracture toughness of reinforced Si3N4 ceramics. In Journal of the American Ceramic Society, 1995, vol. 78, no. 10, p. 2619-2624. ISSN 0002-7820. **128 citations**
5. DUSZA, Ján - MORGIEL, Jerzy - DUSZOVÁ, Annamária - KVETKOVÁ, Lenka - NOSKO, Martin - KUN, Péter - BALÁZSI, Csaba. Microstructure and fracture toughness of Si3N4+graphene platelet composites. In Journal of the European Ceramic Society, 2012, vol. 32, p. 3389-3397. (2011: 2.353 - IF, Q1 - JCR, 1.343 - SJR, Q1 - SJR, Current Contents - CCC). (2012 - Current Contents, WOS, SCOPUS). ISSN 0955-2219.: https://doi.org/10.1016/j.jeurceramsoc.2012.04.022 **124 citations**
6. VIOLA, Giusuppe - MCKINNON, Ruth - KOVAĽ, Vladimír - ADOMKEVICIUS, Arturas - DUNN, Steve - YAN, Haixue. Lithium-induced phase transitions in lead-free Bi0.5Na0.5TiO3 based ceramics. In Journal of Physical Chemistry C, 2014, vol. 118, p. 8564-8570. (2013: 4.835 - IF, Q1 - JCR, 2.134 - SJR, Current Contents - CCC). (2014 - Current Contents, WOS, SCOPUS). ISSN 1932-7447. https://doi.org/10.1021/jp500609h **100 citations**
7. CASTLE, Elinor** - CSANÁDI, Tamás - GRASSO, Salvatore - DUSZA, Ján - REECE, Michael J. Processing and properties of high-entropy ultra-high temperature carbides. In Scientific Reports, 2018, vol. 8, p. 8609-8619. (2017: 4.122 - IF, Q1 - JCR, 1.533 - SJR, Q1 - SJR, Current Contents - CCC). (2018 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. https://doi.org/10.1038/s41598-018-26827-1 **99 citations**
8. DUSZOVÁ, Annamária - DUSZA, Ján - TOMÁŠEK, K. - BLUGAN, Gurdial - KUEBLER, Jakob. Microstructure and properties of carbon nanotube/zirconia composite. In Journal of the European Ceramic Society, 2008, vol. 28, p. 1023-1027. (2007: 1.562 - IF, Q1 - JCR, 1.212 - SJR, Q1 - SJR). (2008 - WOS,

SCOPUS). ISSN 0955-2219. https://doi.org/10.1016/j.jeurceramsoc.2007.09.011 **90 citations**

9. STOYKA, Volodymyr - KOVÁČ, František - STUPAKOV, Oleksandr - PETRYSHYNETS, Ivan. Texture evolution in Fe-3% Si steel treated under unconventional annealing conditions. In Materials Characterization, 2010, vol. 61, p. 1066-1073. (2009: 1.416 - IF, Q1 - JCR, 1.010 - SJR, Q1 - SJR, Current Contents - CCC). (2010 - Current Contents). ISSN 1044-5803. https://doi.org/10.1016/j.matchar.2010.06.020 **86 citations**

10. ŠALAK, Andrej. Ferrous powder metallurgy. Cambridge : Cambridge International Science Publ., 1995. 453 p. ISBN 1-898326-03-7 **85 citations**

2.2.4. List of 10 most-cited publications published during the evaluation period (2016-2021) with the address of the Institute, with number of citations obtained until 2021

1. CASTLE, Elinor** - CSANÁDI, Tamás - GRASSO, Salvatore - DUSZA, Ján - REECE, Michael J. Processing and properties of high-entropy ultra-high temperature carbides. In Scientific Reports, 2018, vol. 8, p. 8609-8619. (2017: 4.122 - IF, Q1 - JCR, 1.533 - SJR, Q1 - SJR, Current Contents - CCC). (2018 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. https://doi.org/10.1038/s41598-018-26827-1 **197 citations**

2. DUSZA, Ján - ŠVEC, Peter Jr. - GIRMAN, Vladimír - SEDLÁK, Richard** - CASTLE, Elinor - CSANÁDI, Tamás - KOVALČÍKOVÁ, Alexandra - REECE, Michael J. Microstructure of (Hf-Ta-Zr-Nb)C high-entropy carbide at micro and nano/atomic level. In Journal of the European Ceramic Society, 2018, vol. 38, no. 12, p. 4303-4307. (2017: 3.794 - IF, Q1 - JCR, 1.068 - SJR, Q1 - SJR, Current Contents - CCC). (2018 - Current Contents). ISSN 0955-2219. https://doi.org/10.1016/j.jeurceramsoc.2018.05.006 **80 citations**

3. LAUDA, M. - FÜZER, J. - KOLLÁR, P. - STREČKOVÁ, Magdaléna - BUREŠ, Radovan - KOVÁČ, Jozef - BAŤKOVÁ, Marianna - BAŤKO, Ivan. Magnetic properties and loss separation in FeSi/MnZnFe2O3 soft magnetic composites. In Journal of Magnetism and Magnetic Materials, 2016, vol. 411, p. 12-17. (2015: 2.357 - IF, Q2 - JCR, 0.730 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents, WOS, SCOPUS). ISSN 0304-8853. https://doi.org/10.1016/j.jmmm.2016.03.051 **59 citations**

4. STREČKOVÁ, Magdaléna - MÚDRA, Erika - ORIŇAKOVÁ, Renáta - MARKUŠOVÁ BUČKOVÁ, Lucia - ŠEBEK, Martin - KOVALČÍKOVÁ, Alexandra - SOPČÁK, Tibor - GIRMAN, Vladimír - DANKOVÁ, Zuzana - MIČUŠÍK, Matej - DUSZA, Ján. Nickel and nickel phosphide nanoparticles embedded in electrospun carbon fibers as favourable electrocatalysts for hydrogen evolution. In Chemical Engineering Journal, 2016, vol. 303, p. 167-181. (2015: 5.310 - IF, Q1 - JCR, 1.676 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 1385-8947. https://doi.org/10.1016/j.cej.2016.05.147 **38 citations**

5. SEDLÁK, Richard - KOVALČÍKOVÁ, Alexandra - MÚDRA, Erika - RUTKOWSKI, Pawel - DUBIEL, Aleksandra - GIRMAN, Vladimír - BYSTRICKÝ, Roman - DUSZA, Ján. Boron carbide/graphene platelet ceramics with improved fracture toughness and electrical conductivity. In Journal of the European Ceramic Society, 2017, vol. 37, p. 3773-3780. (2016: 3.454 - IF, Q1 - JCR, 1.142 - SJR, Q1 - SJR, Current Contents - CCC). (2017 - Current Contents). ISSN 0955-2219. https://doi.org/10.1016/j.jeurceramsoc.2017.04.061 **37 citations**

6. TAPASZTÓ, Orsolya - TAPASZTÓ, Levente - LEMMEL, Hartmut - PUCHÝ, Viktor - DUSZA, Ján - BALÁZSI, Csaba - BALAZSI, K. High orientation degree of graphene nanoplatelets in silicon nitride composites prepared by spark plasma sintering. In Ceramics International, 2016, vol. 42, p. 1002-1006. (2015: 2.758 -

IF, Q1 - JCR, 0.823 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0272-8842. https://doi.org/10.1016/j.ceramint.2015.09.009 **34 citations**

7. SAEIDI, Kamran - KVETKOVÁ, Lenka - LOFAJ, František - SHEN, Zhijian. Novel ferritic stainless steel formed by laser melting from duplex stainless steel powder with advanced mechanical properties and high ductility. In Materials Science and Engineering A - Structural Materials Properties Microstructure and Processing, 2016, vol. 665, p. 59-65. (2015: 2.647 - IF, Q1 - JCR, 1.742 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0921-5093. https://doi.org/10.1016/j.msea.2016.04.027 **34 citations**

8. PIETRIKOVÁ, A. - LUKÁCS, Peter - JAKUBÉCZYOVÁ, Dagmar - BALLÓKOVÁ, Beáta - POTENCKI, Jerzy - TOMASZEWSKI, Grzegorz - PEKAREK, Jan - PŘIKRYLOVÁ, Kateřina - FIDES, Martin. Surface analysis of polymeric substrates used for inkjet printing technology. In Circuit World, 2016, vol. 42, no. 1, p. 9-16. (2015: 0.525 - IF, Q4 - JCR, 0.228 - SJR, Q2 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0305-6120. https://doi.org/10.1108/CW-10-2015-0047 **32 citations**

9. LE GOUPIL, Florian - MCKINNON, Ruth - KOVAĽ, Vladimír - VIOLA, Giusuppe - DUNN, Steve - BERENOV, Andrey - YAN, Haixue - MCN ALFORD, N. Tuning the electrocaloric enhancement near the morphotropic phase boundary in lead-free ceramics. In Scientific Reports, 2016, vol. 6, art. no. 28251. (2015: 5.228 - IF, Q1 - JCR, 2.034 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 2045-2322. https://doi.org/10.1038/srep28251 **30 citations**

10. KOVALČÍKOVÁ, Alexandra - SEDLÁK, Richard - RUTKOWSKI, Pawel - DUSZA, Ján. Mechanical properties of boron carbide+graphene platelet composites. In Ceramics International, 2016, vol. 42, p. 2094-2098. (2015: 2.758 - IF, Q1 - JCR, 0.823 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0272-8842. https://doi.org/10.1016/j.ceramint.2015.09.139 **28 citations**

2.2.5. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations in the assessment period (2015– 2020). The cited papers must bear the address of the institute

1. Ján Dusza: 1843
2. Pavol Hvizdoš: 737
3. František Lofaj: 522
4. Ľubomír Medvecký: 513
5. Vladimír Kovaľ: 498
6. Lenka Kvetková: 478

2.2.6. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations obtained until 2020. The cited papers must bear the address of the Institute

1. Ján Dusza: 2733
2. Pavol Hvizdoš: 1010
3. František Lofaj: 860
4. Ľubomír Medvecký: 703
5. Karel Saksl: 670
6. Eva Dudrová: 657

2.2.7. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations obtained until 2021 of their papers published during the evaluation period (2016– 2021). The cited papers must bear the address of the Institute

1. Ján Dusza: 949
2. Alexandra Kovalčíková: 554
3. Tamás Csanádi: 547
4. Richard Sedlák: 359
5. Erika Múdra: 264
6. Magdaléna Strečková: 248

2.3. Research status of the institute in international and national context

- **International/European position of the institute**

2.3.1. List of the most important research activities demonstrating the international relevance of the research performed by the institute, incl. major projects (details of projects should be supplied under Indicator 2.4). Max. 10 items for institute with less than 50 average FTE researchers per year, max. 20 for institutes with 50 – 100 average FTE researchers per year and so on

1. European XFEL

Doc. Ing. Karel Saksl, DrSc. is the official representative of the Slovak Republic in the Council of the international project the European XFEL. In 2014-2020 he was the representative of the Slovak Republic in two consortia of users Serial Femtosecond Crystallography and the XFEL Biology Infrastructure. In 2009-2013 he was a member of the prestigious Scientific Advisory Committee of the international project the European XFEL. He is a member and scientific secretary of the Ministry of Education, Youth and Sports for the coordination of activities of the Slovak Republic in ESFRI projects focused on materials, physical sciences, with application potential in biological and medical sciences, chemical sciences and IT. He is a member of the DESY Hamburg evaluation panel for X-ray spectroscopy. He is one of the founders of the Hydrogen Technology Center in Košice.

2. KMM-VIN (European Virtual Institute on Knowledge based Multifunctional Materials - https://www.kmm-vin.eu/)

IMR SAS is the Core memmber of The European Virtual Institute on Knowledge-based Multifunctional Materials AISBL (KMM-VIN). KMM-VIN is a self-sustainable organisation which promotes and facilitates cooperative research and development activities of its Members in advanced structural and functional materials. Its goals are Networking with European peer groups in advanced materials, research by promoting internal KMM-VIN research projects, participation in EU project proposals (e.g. H2020), endorsment of research fellowships for young researchers

3. Project: Graphene-ceramic composites for tribological application in aqueous environments

Program M-ERA.NET
Responsible person: Ján Dusza
Period: 2014-2017

4. *Project: Innovative Ni-Cr-Re coatings with enhanced corrosion and erosion resistance for high temperature applications in power generation industry*

Program: M-ERA.Net
Responsible person: Ján Dusza
Period: 2017-2020

5. *Project: Multifunctional Ceramic/Graphene Thick Coatings for New Emerging Application*

Program: M-ERA.Net
Responsible person: Ján Dusza
2018-2020

6. *Project: Leightweight nanocrystalline aluminium based material for space applications (modeling and technology verification)*

Program: M-ERA.Net
Responsible person: František Lofaj
Period: 2015-2016

7. *Project: Durable ceramics composites with superhard particles for wear-resistant cutting tools*

Program: M-ERA.Net
Responsible person: Ján Dusza
Period: 2018-2021

8. *Project: Novel explosive welded corrosion resistant clad materials for geothermal plants*

Program: M-ERA.Net
Responsible person: Karl Saksl
Period: 2014-2017

9 *Industrial Contract project: Preparation of soft magnetic composites for industrial application*

Industrial Partner: Würth Elektronik eiSos GmbH, Germany
Responsible person: Magdeléna Strečková
Period: 2017-2019

10. *Research contract: HuaMag - Research of soft magnetical composites based on powder metallurgy ferromagnetics and dielectric nano-powders.*

Industrial partner: Huawei Technologies, China
Responsible person: Radovan Bureš
Period: 2019-2021

11. *Project: CRM-EXTREME - Solutions for Critical Raw Materials Under Extreme Conditions*

Program: COST Actions
Responsible person: Pavol Hvizdoš
Period 2015-2020

12. *Project: Advanced fibre laser and coherent source as tools for society manufacturing and life science - The surface microstructure modification of steels via the fiber laser*

Program: COST
Responsible person: Ivan Petryshynets
Period: 2014-2018

13. *Project: Strengthening and plasticity of high-entropy ultra-high temperature carbides*

Program: H2020-MSCA-IF

Project leader/responsible person: Tamás Csanádi
Period: 2021

14. *Project: Development of novel multifunctional materials for next generation magnetoelectric sensors and data storage devices*

Program: APVV-SK-CN-2017-0004 (interacademic bilateral agreement)
Project leader/responsible person: Vladimír Kovaľ
Period: 2018-2019

2.3.2. List of international conferences (co)organised by the institute

1. X. Seminar of the Central European PhD students in Materials Science, ÚMV SAV Košice, 04.04.-06.04.2016
2. Kick off meeting: „Som tu, som PROMATECH“, Aula ústavov SAV, Watsonova 47 Košice, 19.04.-19.04.2016
   Workshop SAS - NPU China, Smolenice, 20.06.-22.06.2016
3. Fractography of Advanced Ceramics, Smolenice, 09.10.-12.10.2016
   Workshop SAS-KIMS, Bratislava, 18.10.-19.10.2016
4. Funkčné kompozitné materiály 2017, Ústav materiálového výskumu, Watsonova 47 Košice, 03.10.-03.10.2017
5. Deformation and Fracture in Structural PM Materials, KC Academia Stará Lesná, 22.10.-25.10.2017
6. 13. medzinárodná konferencia Conference Local Mechanical Properties LMP 2017, Pavilón materiálových vied, ÚMV SAV, Košice, 04.11.-06.11.2017
7. Škola používateľov XFEL a synchrotrónového žiarenia "SFEL 2018", Liptovský Ján, 26.05.-31.05.2018
8. Workshop MAV v oblasti materiálových vied, ÚMV SAV, Košice,SR, ÚMV SAV Košice, 01.06.-01.06.2018
9. Funkčné kompozitné materiály 2018, Ústav materiálového výskumu, Watsonova 47, Košice, 16.10.-16.10.2018
10. Príprava a vlastnosti progresívnej keramiky a skiel, Stará Lesná, 29.10.-31.10.2018
11. Metalografia a fraktografia 2019, Atrium hotel, Nový Smokovec, Vysoké Tatry, , 24.04.-26.04.2019
    Fraktografia moderných keramík 2019, KC Smolenice , 08.09.-11.09.2019
12. 1st Virtual ESIS Summer School - VESS1. Tematické sympózium TC6 - Ceramics, Madeira, Portugalsko, 10.07.-10.07.2020
13. 16th International Symposium on Novel and Nano Materials, Phoenix Jeju Kórea, 03.11.-06.11.2020. T. Csanádi bol organizátor sekcie uvedeného sympózia - Session Organizer of Refractory Metals and Hard Materials.
14. BaltMatTrib 2021 - Modern materials and manufacturing (virtuálna konferencia), Tallin/Riga, 27.04.-29.04.2021
15. The 10th Global Conference on Materials Science and Engineering (CMSE 2021), Shenzen, Čína, 01.08.-04.08.2021

2.3.3. List of edited proceedings from international scientific conferences

2016**:**

Seminar "nanoCEXmat" 2016. Košice, 22.11.2016. Ed. Františka Dorčáková, Lucia Čiripová. Košice : Ústav materiálového výskumu SAV, 2016. ISBN 978-80-89782-06-2(NanoCEXmat 2016).

Workshop Processing and properties of advanced ceramics, November 23-25, 2016, Ružín, Slovak Republic : book of extended abstracts. Recenzenti: Dušan Galusek, Karel Maca, Zoltán Lenčéš, Miroslav Hnatko, Jaroslav Sedláček, Marián Mikula, Alexandra Kovalčíková; editor Jana Valúchová. Bratislava, Slovak Republic : Institute of Inorganic Chemistry SAS, 2016. 104 p. ISBN 978-80-971648-5-0(Processing and properties of advanced ceramics).

Kovové materiály. Editor Juraj Lapin ; technical editor Natália Mináriková. Bratislava : Ústav materiálov a mechaniky strojov SAV : Ústav materiálového výskumu SAV, 1963-. 6x/year. ISSN 0023-432X.

Fractography of advanced ceramics : The international conference FAC 2016. Book of abstracts. Smolenice, 9.-12.10.2016. Košice : Institute of materials research SAS, 2016. ISBN 978-80-89782-05-5(Fractography of advanced ceramics : The international conference FAC 2016).

Acta Metallurgica Slovaca. Košice : Technická univerzita - Hutnícka fakulta : Ústav materiálového výskumu SAV. ISSN 1338-1156.

Powder Metallurgy Progress : Journal of Science and Technology of Particle Materials. Košice : Ústav materiálového výskumu SAV. ISSN 1335-8978.

2017:

Deformation and fracture in PM materials DFPM 2017 : International conference. Book of abstracts. Stará Lesná, 22.-25.10.2017. Ed. Beáta Ballóková, Katarína Ondrejová. Košice : Institute of Materials Research SAS, 2017. 100 p. ISBN 978-80-89782-07-9(Deformation and fracture in PM materials DFPM 2017 : International conference).

Kovové materiály - Metallic Materials. Editor Juraj Lapin ; technical editor Natália Mináriková. Bratislava : Ústav materiálov a mechaniky strojov SAV : Ústav materiálového výskumu SAV, 1963-. 6x ročne. ISSN 0023-432X.

Funkčné kompozitné materiály : Konferencia s medzinárodnou účasťou. Zborník abstraktov. Košice, 3.10.2017. Košice : ÚMV SAV, 2017. ISBN 978-80-89782-08-6 (Funkčné kompozitné materiály : Konferencia s medzinárodnou účasťou).

13th conference on local mechanical properties : Book of abstracts. Košice, 6.-8.11.2017. Košice : ÚMV SAV, 2017(Conference on Local mechanical properties).

Powder Metallurgy Progress : Journal of Science and Technology of Particle Materials. Košice : Ústav materiálového výskumu SAV. ISSN 1335-8978.

Acta Metallurgica Slovaca. Košice : Technická univerzita - Hutnícka fakulta : Ústav materiálového výskumu SAV. ISSN 1338-1156.

Special Issue of Journal of the European Ceramic Society, Fractography of Advanced Ceramics V “Fractography from MACRO- to NANO-scale”, Managing Guest Editor: Pavol Hvizdoš, JECS 2017, vol.37, No 14.

2018:

Kovové materiály = Metallic Materials. Editor Juraj Lapin ; technical editor Natália Mináriková. Bratislava : Ústav materiálov a mechaniky strojov SAV : Ústav materiálového výskumu SAV, 1963-. 6x ročne. ISSN 0023-432X.

Processing and properties of advanced ceramics and glasses, Stará Lesná - High Tatras, Slovakia, October 29 - 31, 2018 : conference proceedings. Eds. Erika Múdra, Alexandra Kovalčíková. Košice, Slovak Republic : Institute of Materials Research, Slovak Academy of Sciences, 2018. ISBN 978-80-89782-10-9(Processing and Properties of Advanced Ceramics and Glasses. Joint Annual Meeting of the Slovak Silicate Scientific-Technological Society & KIMS Korea-SAS Slovakia Workshop on Advanced Ceramics & FunGLASS conference on Functional Materials).

Soft magnetic materials designed for highly efficient electric motors and generators : Conference Proceedings. Košice, 15.3.2018. Ed. Ivan Petryshynets. Košice : Ústav

materiálového výskumu SAV, 2018. ISBN 978-80-89782-09-3(Soft magnetic materials designed for highly efficient electric motors and generators).

Powder Metallurgy Progress : Journal of Science and Technology of Particle Materials. Košice : Ústav materiálového výskumu SAV. ISSN 1335-8978.

Funkčné kompozitné materiály - Functional composite materials : Abstract Book - Zborník abstraktov. Košice, 16.10.2018. Košice : Ústav materiálového výskumu SAV, 2018. ISBN 978-80-89782-11-6(Funkčné kompozitné materiály).

Acta Metallurgica Slovaca. Košice : Technická univerzita - Hutnícka fakulta : Ústav materiálového výskumu SAV. ISSN 1338-1156.

2019:

Fractography of advanced ceramics FAC 2019 : The International conference. Book of abstracts. Smolenice, 8.-11.9.2019. Eds. Erika Múdra, Alexandra Kovalčíková, Ján Dusza. Košice : Institute of Materials Research SAS, 2019. ISBN 978-80-89782-12-3(Fractography of advanced ceramics FAC 2019 : The international conference).

Preparation of ceramic materials : Proceedings of the 13th international conference. Jahodná, 25.-27.6.2019. Eds. B. Plešingerová, D. Medveď. Košice : Technical University, 2019. 206 p. ISBN 978-80-553-3314-4(Preparation of ceramic materials : international conference).

2020

Special Issue of Journal of the European Ceramic Society, Fractography of Advanced Ceramics VI, Managing Guest Editor: Pavol Hvizdoš, JECS 2020, vol 40, No 14, ISSN 0955-2219, eISSN 1873-619X.

2.3.4. List of journals edited/published by the institute and information on their indexing in WOS, SCOPUS, other database or no database, incl. impact factor and other metrics of journals in each year of the assessment period

WOS: Kovové materiály ISSN 0023-432X

IF2015: 0,365

IF2016: 0,366

IF2017: 0,636

IF2018: 0,593

IF2019: 0,765

IF2020: 1,068

SCOPUS: Acta Metallurgiuca Slovaca ISSN 1335-1532

SCOPUS: Powder Metallurgy Progress ISSN 1335-8978

- **National position of the institute**

2.3.5. List of selected activities of national importance

2.3.6. List of journals (published only in the Slovak language) edited/published by the institute and information on their indexing in WOS, SCOPUS, other database or no database, incl. impact factor and other metrics of journals in each year of the assessment period

- **Position of individual researchers in the international context**

2.3.7. List of invited/keynote presentations at international conferences, as documented by programme or invitation letter

2016

SAKSL, Karel - SZULC, Zygmunt - GLOC, Michal - MILKOVIČ, Ondrej - ĎURIŠIN, Juraj Jr. - CIUPIŃSKI, Lukasz - ARNBJÖRNSSON, Adalsteinn - OSTROUSHKO, Dmytro - MAZANCOVÁ, Eva. Evaluation of residual strains and stresses using two-dimensional X-ray difraction. In Metal 2016 : 25th anniversary international conference on metallurgy and materials. Brno, 25.-27.5.2016. - Ostrava : Tanger Ltd., 2016, p. 30. ISBN 978-80-87294-66-6.(Metal 2016 : anniversary international conference on metallurgy and materials).

BUREŠ, Radovan. Advances in powder metallurgy soft magnetic composite materials. In ISNNM-2016 : 14th international symposium on novel and nano materials. Budapest, 3.-8.7.2016. - B.V., 2016, p. 37.(ISNNM-2016 : international symposium on novel and nano materials).

DUSZA, Ján. Anisotropy in elastic and plastic behaviour of advanced ceramics at nano level. In ICC6 : 6th international congress on ceramics. Abstracts. Dresden, 21.-25.8.2016. - Köln : Deutsche Keramische Gesellschaft, 2016, p. 100.(ICC6 : international congress on ceramics).

DUSZA, J.: Nano-mechanical characterization of advanced ceramics. In: ISNNM-2016. 14th international symposium on novel and nano materials. Budapest, 3.-8.7.2016. B.V. 2016

SEDLÁK, Richard - BALKO, Ján - KOVALČÍKOVÁ, Alexandra - GIRMAN, Vladimír - RUTKOWSKI, Pawel - ZIENTARA, D. - PUCHÝ, Viktor - DUSZA, Ján. B4C+graphene platelet composites - processing, microstructure and properties. In Workshop on graphene/ceramic composites : Programme and abstracts. Cuenca (Spain), 28.-30.9.2016. - B.V., 2016, p. 65.(Workshop on graphene/ceramic composites).

2017

DUSZA, Ján. Nano-mechanical testing of advanced ceramics. In ECerS 2017 : 15th International Conference and exhibition of the European Ceramic Society. Book of abstracts. Budapest, 9.-13.7.2017. - B.V., 2017.(ECerS 2017 : International Conference and exhibition of the European Ceramic Society).

ŠAJGALÍK, Pavol - HNATKO, Miroslav - LENČÉŠ, Zoltán - DUSZA, Ján - TATARKO, Peter - KOVALČÍKOVÁ, Alexandra - KAŠIAROVÁ, Monika. Thermal shock resistance, wear behavior and oxidation resistance of silicon nitride based nano-composites. In PACRIM 12. The 12th pacific rim conference on ceramic and glass technology including - glass and optical materials division annual meeting (GOMD 2017), May 21 - 26, 2017, Waikoloa, Hawaii : abstract book. - USA : The American Ceramic Society, 2017, p. 54.(PACRIM 12. Pacific Rim Conference on Ceramics and Glass Technology including - Glass and Optical Materials Division Annual Meeting (GOMD 2017)).

ŠAJGALÍK, Pavol - HNATKO, Miroslav - LENČÉŠ, Zoltán - DUSZA, Ján - TATARKO, Peter - KOVALČÍKOVÁ, Alexandra - KAŠIAROVÁ, Monika. Thermal shock resistance, wear behavior and oxidation resistance of silicon nitride based nano-composites. In ICACC 2017. 41st international conference and exposition on advanced ceramics and composites, january 22 - 27, 2017, Hilton Daytona Beach Resort and Ocean Center, Daytona Beach, Florida, USA : abstract book. - USA : The American Ceramic Society, 2017, p. 2.(ICACC 2017. International Conference and Exposition on Advanced Ceramics and Composites).

LOFAJ, František - NÉMETH, Dušan. Finite Element Modeling of Scratch Testing of the W-C Coating/Steel Substrate System Based on Nanoindentation, Vrstvy a povlaky 2017, Rožnov pod Radhoštěm, 23.-24.10.2017, Česká republika

LOFAJ, František. FEM of nanoindentation and scratch testing for the understanding of tribological processes in the coated systems**,** 2nd Czech-Japan Tribology Workshop, 13-15.11.2017, Tokushima, Japan

PETRYSHYNETS, Ivan. Abnormal growth of goss grains in grain oriented silicon steel driven by distribution characteristics of VC nanoparticles. In: Konferencia "EMN soft materials meeting". Vienna, Rakúsko. 18.-22.6.2017

2018

SEDLÁK, Richard - KOVALČÍKOVÁ, Alexandra - RUTKOWSKI, Pawel - DUBIEL, Aleksandra - GRASSO, Salvatore - PORWAL, Harshit - GIRMAN, Vladimír - FIDES, Martin - MÚDRA, Erika - BALKO, Ján - REECE, Michael J. - DUSZA, Ján. Effect of different processing technologies on development of boron carbide/graphene platelets ceramics. In *2nd Polish-Slovak-Chinese seminar on ceramics, Kraków, September 9th-13th 2018 : book of abstracts*. Eds. Zbigniew Pedzich, Chengyu Zhang, Zongyang Shen. - Kraków, Poland : Polish Ceramic Society, 2018, p. 31. ISBN 978-83-65955-13-5.(Polish-Slovak-Chinese seminar on ceramics).

KOVALČÍKOVÁ, Alexandra - SEDLÁK, Richard - BALKO, Ján - DUSZOVÁ, Annamária - BACZEK, Elžbieta - PODSIADLO, Marcin - DUSZA, Ján. Wear and thermal shock resistance of ZrB2 based ceramic composites. In *2nd Polish-Slovak-Chinese seminar on ceramics, Kraków, September 9th-13th 2018 : book of abstracts*. Eds. Zbigniew Pedzich, Chengyu Zhang, Zongyang Shen. - Kraków, Poland : Polish Ceramic Society, 2018, p. 41. ISBN 978-83-65955-13-5.(Polish-Slovak-Chinese seminar on ceramics).

SAKSL, Karel - JASMINSKÁ, Natália - BRESTOVIČ, Tomáš - MOLČANOVÁ, Zuzana - ŠULÍKOVÁ, Michaela - ŠUĽOVÁ, Katarína - FEJERČÁK, Miloš - MICHALIK, Štefan. Microstructure, mechanical properties and hydrogen storage of Cr1-xCuxMnFeNi high entropy alloys. In *International workshop on Advanced materials science and nanotechnology : Programme and abstracts. Ninh Binh City, Vietnam, 7.-11.11.2018*. - B.V., 2018, p. 194-195. ISBN 97860490733062.(International workshop on Advanced materials science and nanotechnology).

BUREŠ, Radovan - FÁBEROVÁ, Mária - BIRČÁKOVÁ, Zuzana - HALAMKA, M. - HADRABA, Hynek - ROUPCOVÁ, Pavla - SAKSL, Karel. Preparation and properties of FeSiBAlNiMo high entropy alloy. In *International workshop on Advanced materials science and nanotechnology : Programme and abstracts. Ninh Binh City, Vietnam, 7.-11.11.2018*. - B.V., 2018, p. 195-196. ISBN 97860490733062.(International workshop on Advanced materials science and nanotechnology).

DUSZA, Ján. Nano-mechanical testing of ZrB2 ceramics. In *14th International ceramic congress CIMTEC 2018. Perugia, 4.-8.6.2018*. - B.V., 2018, p. non.(International ceramic congress CIMTEC 2018).

HVIZDOŠ, Pavol. Development of new SiC nanocomposites with enhanced electrical conductivity. In *7th Global conference on materials science and engineering : CMSE 2018. Xian, China, 1.-4.11.2018*. - B.V., 2018, p. 35/114.(Global conference on materials science and engineering CMSE 2018).

HVIZDOŠ, Pavol. Development of SiC based nanocomposites with enhanced electrical conductivity. In *15th annual congress on Materials research and technology. Paris, 19.-20.2.2018*. - B.V., 2018, p. 41. ISSN 2169-0022.(annual congress on Materials research and technology).

FIDES, Martin, SEDLÁK, Richard, HVIZDOŠ, Pavol. DB4-Based Ceeramics Prepare by SPS an Flas SPS. In *2nd Polish-Slovak-Chinese Seminar on Ceramics, Sept. 9.-12.2018, Krakow, Poľsko.*

DUSZA, Ján. Nano-mechanical testing of advanced ceramics. In *Book of abstracts. FEMS JUNIOR EUROMAT CONFERENCE 2018*. - Budapešť : Akadémiai Kiadó, 2018, p. 3-4. ISBN 978-

96-05-9917-7.(FEMS Junior EUROMAT CONFERENCE 2018).

DUSZA, Ján. Ceramic-graphene nanocomposites. In *ISNNM 2018 : 15th International symposium on novel and nano materials. Lisbon, Portugal, 1.-6.7.2018*. - B.V., 2018, p. non.(ISNNM 2018 : International symposium on novel and nano materials).

HVIZDOŠ, Pavol: Advanced SiC-graphene and SiC-CNT composites with enhanced electrical conductivity. APMAS 2018. 8th international advances in applied physics and materials science congress and exhibition. Mugla, 24.-30.4.2018

LOFAJ, František, NÉMETH, Dušan: Finite Element Modeling of Nanoindentation and Scratch Testing in the Hard Coating/Softer Substrate System, medzinárodná konferencia „IIW6“, Sapporo, Japan, 30.6.-8.7.2018.

LOFAJ, František, KABÁTOVÁ, Margita, KLICH, M., MEDVEĎ, Dávid., DOBROVODSKÝ, J., NOGA, P.: The effect of hydrogen on structure and tribological properties of W-C/a-C:H coatings, 2nd Polish-Slovak-China Seminar on Ceramics. Krakow, Poland, 10.-12.9.2018.

2019

SEDLÁK, Richard - FIDES, Martin - HVIZDOŠ, Pavol - GRASSO, Salvatore - GIRMAN, Vladimír - REECE, Michael J. Boron carbide based ceramic composites prepared by SPS and flash sintering. In *11th International conference on the Science of hard materials ICSHM11 : Extended abstracts. Khao Lak, Thailand, 25.-29.3.2019*. - B.V., 2019, p. 155-156.(International conference on the Science of hard materials : ICSHM11).

SEDLÁK, Richard. Development of boron carbide/graphene platelets ceramics prepared by different processing technologies. Place: Northwestern Polytechnical University, Xi'an, China, 31.05.2019

ŠAJGALÍK, Pavol - SEDLÁČEK, Jaroslav - KOVALČÍKOVÁ, Alexandra - HAN, X. - ZHANG, Chengyu. Ultra-high creep resistant silicon carbide ceramics. In *XVI ECerS Conference, Torino, Italy, 16-20 June 2019 : abstract book*. - Italy, 2019, p. 236.(ECerS : Conference and Exhibition of the European Ceramic Society).

SAKSL, Karel - MOLČANOVÁ, Zuzana - ĎURIŠIN, Juraj Jr. - JÓVÁRI, P. - PETHES, Ildikó - TEMLEITNER, László - MICHALIK, Štefan - BALLÓKOVÁ, Beáta - KAPUSCINSKÝ, Lukáš - ŠUĽOVÁ, Katarína - ŠULÍKOVÁ, Michaela - FEJERČÁK, Miloš. Development of new biodegradable alloys for medical applications. In *METAL 2019 - ABSTRACTS : 28th international conference on Metallurgy and Materials*. - Ostrava : Tanger Ltd., 2019, p. 68. ISBN 978-80-87294-91-8.(METAL 2019 : 28th International Conference on Metallurgy and Materials).

ZHOU, Xiaobing - TATARKO, Peter - KOVALČÍKOVÁ, Alexandra - DLOUHÝ, Ivo - HUANG, Z. - HUANG, Q. SiC ceramics joined with an in-situ reaction gradient layer of TiC/Ti3SiC2 using electric field-assisted sintering technique. In *Engineering Ceramics 2019, Advanced Research Workshop: Ceramics for people, Smolenice castle, May 12-16, 2019 : book of abstracts*. Eds. Zoltán Lenčéš, Jana Valúchová. - Bratislava, Slovakia : Institute of Inorganic Chemistry, Slovak Academy of Sciences, 2019, p. 52. ISBN 978-80-971648-7-4.(Engineering Ceramics 2019 : Ceramics for people).

HAN, X. - ZHANG, C. - REECE, Michael J. - DUSZA, Ján. Compressive creep behaviors of SPS (Ta-Hf-Zr-Nb)C high entropy ceramics. In *Engineering Ceramics 2019, Advanced Research Workshop: Ceramics for people, Smolenice castle, May 12-16, 2019 : book of abstracts*. Eds. Zoltán Lenčéš, Jana Valúchová. - Bratislava, Slovakia : Institute of Inorganic Chemistry, Slovak Academy of Sciences, 2019, p. 62. ISBN 978-80-971648-7-4.(Engineering Ceramics 2019 : Ceramics for people).

CSANÁDI, Tamás - CASTLE, Elinor - REECE, Michael J. - DUSZA, Ján. High-entropy carbides: A novel group of materials for extreme environments. In *Engineering Ceramics 2019, Advanced Research Workshop: Ceramics for people, Smolenice castle, May 12-16, 2019 : book of abstracts*. Eds. Zoltán Lenčéš, Jana Valúchová. - Bratislava, Slovakia : Institute of Inorganic Chemistry, Slovak Academy of Sciences, 2019, p. 45. ISBN 978-80-971648-7-4.(Engineering Ceramics 2019 : Ceramics for people).

DUSZA, Ján. Nano-mechanical testing of ZrB2 ceramics. In *Engineering Ceramics 2019, Advanced Research Workshop: Ceramics for people, Smolenice castle, May 12-16, 2019 : book of abstracts*. Eds. Zoltán Lenčéš, Jana Valúchová. - Bratislava, Slovakia : Institute of Inorganic Chemistry, Slovak Academy of Sciences, 2019, p. 63. ISBN 978-80-971648-7-4.(Engineering Ceramics 2019 : Ceramics for people).

DUSZA, Ján. Small-scale mechanical testing of hardmetals: from micro to nano approach. In *Metallography and Fractography 2019 : 17th international symposium on metallography, fractography and materials science. Abstract booklet. Nový Smokovec, 24.-26.4.2019*. - Košice : Technical University, 2019, p. 20. ISBN 978-80-553-3285-7.(Metallography and Fractography 2019 : international symposium on metallography, fractography and materials science).

ORIŇÁKOVÁ, Renáta - GOREJOVÁ, Radka - HAVEROVÁ, L. - ORIŇÁK, Andrej - KUPKOVÁ, Miriam - HRUBOVČÁKOVÁ, Monika. Štúdium koróznych vlastností a biokompatibility degradovateľných biomateriálov. In *Funkčné kompozitné materiály : Zborník abstraktov. Košice, 16.10.2018*. - Košice : Ústav materiálového výskumu SAV, 2018, p. 6. ISBN 978-80-89782-11-6.(Funkčné kompozitné materiály).

DUSZA, Ján. Nano- mechanical testing and nano- fractography of advanced ceramics. In *Fractography of advanced ceramics FAC 2019 : The International conference. Book of abstracts. Smolenice, 8.-11.9.2019*. Eds. Erika Múdra, Alexandra Kovalčíková, Ján Dusza. - Košice : Institute of Materials Research SAS, 2019, p. no. ISBN 978-80-89782-12-3.(Fractography of advanced ceramics FAC 2019 : The international conference).

LOFAJ, František. The influence of hydrogenation and hybridization on mechanical and tribological properties of hard W-C:H coatings
konferencia 7th International Conference on Advanced Plasma Technologies - ICAPT7, Hue, Vietnam, 22.2.-2.3.2019

LOFAJ, František. The role of hydrogen in friction behavior of hybrid PVD-PECVD W-C:H coatingskonferencia 3rd Czech-Japan Tribology Workshop, Hnanice (u Brna), CR, October 27 – 30, 2019

PETRYSHYNETS, I.: Surface domain structures optimization of soft magnetic materials via the fibre laser scribing. 21st International Conference on Transparent Optical Networks ICTON 2019. Angers, 9.-13.7.2019

DUSZA, J.: Nano-mechanical testing of advanced ceramics. 3rd global conference and expo on Applied science, engineering and technology and 6th global congress and expo on Materials science and nanoscience. Dubai, 7.-9.10.2019

KOVÁČ, F.: Investigation of dynamic annealing effects on the magnetic properties evolution of highstrength non-oriented electrical steels. 3rd International conference and expo on Condensed matter physics. Dubai, 7.-9.10.2019

PETRYSHYNETS, I.: Surface domain structures modification of Fe-Si alloys by the fibre laser processing. 3rd International conference and expo on Condensed matter physics. Dubai, 7.-9.10.2019

SAKSL, K.: Residual stresses in bimetal designed for geothermal applications. ICBM13. 13th international conference on Barkhausen noise and micromagnetic testing. Praha, 23.-26.9.2019

SAKSL, K.: Development of new biodegradable alloys for medical purposes. IWNA 2019. 7th international workshop on nanotechnology and application. Phan Thiet, 6.-9.11.2019. Vietnam National University 2019

DUSZA, J.: Nano-mechanical testing of advanced ceramics. Materials Structure and Micromechanics of Fracture. MSMF 2019, Brno.

2020

DUSZA, J.: Development and characterisation of high-entropy carbides. 16th international symposium on novel and nano materials 2020. Keynote lecture. Jeju Island, Korea, 3.-6.11.2020

LOFAJ, F.: A review of mechanical and tribological properties of hydrogenated W-C:H coatings prepared by different sputtering techniques. 2020 Hydrogenius and I2CNER tribology symposium. Kyushu, 30.1.2020

DUSZA, J.: Korszerükerámiák deformációja és törése kis mérettartományban mikro- és nanomechanikai vizsgálatok során. 25. Fiatal müszakiak tudományos ülésszakának videokonferenciáján (FMTU)

DUSZA, J.: Development and characterisation of high-entropy carbides. 2nd International conference on Central European critical infrastructure protection. Budapest, 16.-17.11.2020

BUREŠ, R.: Metal magnetic particle coating technology. 3rd Huawei magnetic innovations summit. Vienna, 24.-25.9.2020

2021

LOFAJ, F.: The effects of tip blunting on the determination of mechanical properties of thin hard coatings by nanoindentation. ICAMMC 2021. International conference on advanced materials and mechanical characterization. Chennai, 2.-4.12.2021

LOFAJ, F.: Elastic properties of thin hard coatings by nanoindentation - some problems and solutions. Indentation 2021. Lorient, 13.-15.10.2021

SAKSL, K.: High-entropy alloys for hydrogen storage. IWAMSN 2021. 10th International workshop on Advanced materials science and nanotechnology. Hanoi, 4.-6.11.2021

2.3.8. List of researchers who served as members of the organising and/or programme committees

2016:

Name	Programme com.	Organising com.	Programme and organising com.
Andrejovská Jana	0	1	0
Dusza Ján	0	4	0
Hvizdoš Pavol	4	1	0
Kovalčíková Alexandra	0	3	1
Lofaj František	0	1	2
Sum	**4**	**10**	**3**

2017:

Name	Programme com.	Organising com.	Programme and organising com.
Ballóková Beáta	0	0	1
Bureš Radovan	0	0	1
Dusza Ján	0	1	0
Fáberová Mária	0	1	0
Hvizdoš Pavol	2	1	0
Jakubéczyová Dagmar	0	1	0
Kočík Marek	0	1	0
Kovalčíková Alexandra	0	1	0
Kupková Miriam	2	0	0
Lofaj František	1	0	1
Strečková Magdaléna	1	0	0
Sum	**6**	**6**	**3**

2018:

Name	Programme com.	Organising com.	Programme and organising com.
Bureš Radovan	0	0	1
Dusza Ján	1	0	4
Fáberová Mária	0	1	0
Kovalčíková Alexandra	0	0	1
Lofaj František	2	0	0
Múdra Erika	0	0	1
Saksl Karel	0	1	0
Sum	3	2	7

2019:

Name	Programme com.	Organising com.	Programme and organising com.
Dusza Ján	0	0	3
Hvizdoš Pavol	2	0	2
Ivor Michal	0	1	0
Kovalčíková Alexandra	0	0	1
Lofaj František	2	0	0
Múdra Erika	0	1	1
Saksl Karel	0	1	0
Sum	4	3	7

2020:

Name	Programme com.	Organising com.	Programme and organising com.
Dusza Ján	3	0	2
Hvizdoš Pavol	0	0	1
Lofaj František	1	0	0
Sum	4	0	3

2021:

Name	Programme com.	Organising com.	Programme and organising com.
Hvizdoš Pavol	3	0	0
Lofaj František	2	0	1
Sum	5	0	1

2.3.9. List of researchers who received an international scientific award

2016:

Dusza Ján
Anyos JEDLIK Award
Awarded by: Hungarian Intellectual Property Office, Kuratórium A. Jedlik, Hungary
Description: For outstanding contribution in natural sciences

Dusza Ján
Adjunct professor
Awarded by: NWPU Xi'an, China
Description: Ackonwledgement as a World expert in structural ceramics

Lofaj František
Gold medal of 5th Macao Int. Innovation and Invention Expo 2016
Awarded by: 5th Macao Int. Innovation and Invention Expo 2016
Description: Gold medal for the development of a lightweight construction material for a robotic manipulator arm for space applications. Award given to the team of authors.

Németh Dušan
2. place in a poster competition of the international conference FAC 2016
Awarded by: Organiser of FAC 2016, European Ceramic Society

Németh Dušan
Best presentation award
Awarded by: Organiser of ISNNM, Korean PM Institute, South Korea
Description: Awards at Conference 14 ISNNM, Budapest.

Sedlák Richard
1. place: Best poster at conference FAC 2016
Awarded by: Organiser of FAC 2016

Sedlák Richard
Best poster award
Awarded by: Organiser of ISNNM, Korean PM Institute, South Korea
Description: Awards at Conference 14 ISNNM, Budapest.

2017:

Besterci Michal
Monte et manu
Awarded by: Technická univerzita Talin, Estónsko
Description: Award from the Rector of the University for long-term cooperation

Dusza Ján
Medaila Poľskej keramickej spoločnossti
Awarded by: Poľská keramická spoločnosť
Description: Medal awarded for cooperation in the field of progressive ceramic materials

Fides Martin
Young Tribologist Award of the Japan Society of Tribologists
Awarded by: Japanese Society of Tribologist JAST, Japonsko
Description: Grant for conference fee and funds for annual conference of JAST

Kovalčíková Alexandra
2nd Best Poster 2017 ICACC
Awarded by: The American Ceramic Society

Description: 2nd place in the Best Poster category at the International Conference and Expo on Advanced Ceramics and Composites, Florida

Sedlák Richard
Young Tribologist Award of the Japan Society of Tribologists
Awarded by: Japanese Society of Tribologist JAST, Japonsko
Description: Grant for conference fee and funds for annual conference of JAST

Shepa Ivan
IUPAC Poster Award
Awarded by: International Union of Pure and Applied Chemistry, Prof. Natalia Tarasova, president
Description: Poster competition at 69th Annual Congress of Slovak&Czech Chemists

2018:

Ballóková Beáta
Award „Emerald Literati Award in 2018“
Awarded by: Emerald Publishing
Description: „Emerald Literati Award in 2018“, for the paper: Investigation of nano-inks' behaviour on flexible and rigid substrates under various conditions, autorov: P. Lukacs, A. Pietrikova, B. Ballokova, D. Jakubeczyova, O. Kovac in Circuit World

Csanádi Tamás
Cena Acta Student Award 2017
Awarded by: ASM International (Acta Materialia), Columbus, Ohio, USA
Description: International award for the publication published in the Acta Materialia entitled "Slip activation controlled nanohardness anisotropy of ZrB2 ceramic grains".https://www.materialstoday.com/biomaterials/news/recipients-of-the-2017-acta-student-awards/https://www.journals.elsevier.com/acta-materialia/news/recipients-of-the-2017-acta-student-awards

Jakubéczyová Dagmar
Circuit World - 2018 Highly Commended Award
Awarded by: Tony Roche, Publishing Director Emerald Publishing Limited
Description: The winning an Emerald Literati Award in 2018 - for contribution to Circuit World with article „ Investigation of nano-inks“ behaviour on flexible and rigid substrates under various conditions“.

2019:

Sedlák Richard
Award: 3 month post-doc grant – JECS Trust Contract 2018194
Awarded by: JECS Trust

Shepa Ivan
Trustee Award of the Engineering Ceramics Division of American Ceramic Society
Awarded by: American Ceramic Society
Description: Best Poster Awards 2019 at 43th International Conference on Advanced Ceramics and Composites, USA

Sedlák Richard
3. place in Poster section – Fractography of Advanced Ceramics 2019
Awarded by: Organiser of FAC 2019

Dusza Ján
Alexander von Humboldt Award
Awarded by: Foundation "Alexander von Humboldt-Stiftung"

- **Position of individual researchers in the national context**

2.3.10. List of invited/keynote presentations at national conferences, as documented by programme or invitation letter

2016

BALKO, J.: Hodnotenie povrchov pomocou konfokálnej mikroskopie. 1st advanced microscopy symposium. Košice, 15.-16.11.2016

KEPIČ, J.: Technologický transfer objektívom mikroskopu. 1st advanced microscopy symposium. Košice, 15.-16.11.2016

SAKSL, K.: Vnútorné napätia v materiáloch, aplikácia 2D rtg. Difrakčnej analýzy na dátach získaných pomocou synchrotronového žiarenia. 22. Konferencia slovenských fyzikov. Košice, 5.-8.9.2016

2017

CSANÁDI, Tamás - DUSZA, Ján. Low-scale mechanical testing of ceramics. In 13th conference on local mechanical properties : Book of abstracts. Košice, 6.-8.11.2017. - Košice : ÚMV SAV, 2017. (Conference on Local mechanical properties).

DUSZA, Ján. Nano-mechanical testing of WC-Co hardmetals. In Deformation and fracture in PM materials DFPM 2017 : International conference. Book of abstracts. Stará Lesná, 22.-25.10.2017. Ed. Beáta Ballóková, Katarína Ondrejová. - Košice : Institute of Materials Research SAS, 2017, p. 14. ISBN 978-80-89782-07-9. (Deformation and fracture in PM materials DFPM 2017 : International conference).

DUSZA, Ján. Nanomechanical Testing of hard materials. In The 3rd international conference on nanomaterials: fundamentals and applications : Book of abstracts. Štrbské Pleso, 9.-11.10.2017. - NFA, 2017. ISBN 978-80-8152-530-8.(international conference on nanomaterials: fundamentals and applications).

SAKSL, Karel - FRONCZEK, Dagmara Malgorzata - SZULC, Zygmunt - MICHALIK, Štefan - ŠUĽOVÁ, Katarína - ŠULÍKOVÁ, Michaela - LACHOVÁ, Adriana. Explosion welding an unconventional method for fabrication of composite materials. In Funkčné kompozitné materiály : Konferencia s medzinárodnou účasťou. Zborník abstraktov. Košice, 3.10.2017. - Košice : ÚMV SAV, 2017, s. 7.

BUREŠ, Radovan: Additive manufacturing - 3D printing, USSteel Košice, 17. december 2016

MEDVECKÝ, Ľubomír: Súčasné biopolymérne kompozity a ich aplikácie, FKM 2017

LOFAJ, František - vyzvaná prednáška na kolokviu k 80. narodeninám M. Besterciho, Košice, 28.3.2018

2018

HVIZDOŠ, Pavol. Základný a aplikovaný vedecký výskum na ÚMV SAV Košice - infraštruktúra a vedecké aktivity. In *Pokroky v anorganickej chémii : 3. konferencia. Zborník abstraktov. Levoča, 17.-21.6.2018*. - Košice : UPJŠ, 2018, s. 29. ISBN 978-808152-615-2.(Pokroky v anorganickej chémii : konferencia).

KEPIČ, Ján: Využitie mikroskopov výskumného centra PROMATECH v priemyslnej praxi. 7. ročník NDT zákaznícke sympózium SlovCert, . Vígľaš, 5.-6.6.2018

BUREŠ, Radovan.: Pozvaná prednáška : Workshop U.S. Steel -SAV Košice 29.-30.5.2018: „Powder technology and potential of Additive manufacturing“

2019
ORIŇÁKOVÁ, R. - GOREJOVÁ, R. - ORSÁGOVÁ KRÁLOVÁ, Z. - ORIŇÁK, A. - KUPKOVÁ, M. - HRUBOVČÁKOVÁ, M.: Rozložiteľné železné biomaterály s polymérnym povlakom. In: ChemZi, 15, 2019, no. 1, s.72

2021
SAKSL, K.: Lightweight medium-entropy alloys for hydrogen storage. NFA 2021. 5th international conference on nanomaterials: fundamentals and applications. Štrbské Pleso, 10.-13.10.2021. Košice : UPJŠ 2021

STREČKOVÁ, M.: Hydrogen - fuel of the future?. Spring electrochemical meeting. Košice, 20.5.2021. Košice : UPJŠ 2021

2.3.11. List of researchers who served as members of organising and programme committees of national conferences

2016:

Name	Programme com.	Organising com.	Programme and organising com.
Dorčáková Františka	0	0	3
Čiripová Lucia	0	1	0
Sum	0	1	3

2017:

Name	Programme com.	Organising com.	Programme and organising com.
Dorčáková Františka	0	0	1
Sum	0	0	1

2.3.12. List of researchers who received a national scientific award

2016:

On 7th May 2016 the City Council in Košice awarded the **City of Košice Prize** to the Institute of Materials Research of the Slovak Academy of Sciences on the occasion of the 60th anniversary of its **establishment for achievements in scientific research and merits for the development of the city of Košice**.

2017:

Csanádi Tamás, Németh Dušan, Kovalčíková Alexandra, Naughton-Duszová Annamária
SAS Award - young research team
Awarded by: Presidium SAS
Description: For significant contribution to the research of nanomechanical properties of ceramic materials.

Sopčák Tibor
Young scientist under 35 year of age
Awarded by: Presidium SAS
Description: 2. place in "Young scientist under 35"

Hvizdoš Pavol
Commemorative coin of the Faculty of Materials, Metallurgy and Recycling TUKE
Awarded by: dean of the FMMR TUKE
Description: Award on occasion of 65 anniversary of the faculty.

Hvizdoš Pavol
Platinum medal of the Faculty of Mechanical Engineering TUKE
Awarded by: dean of SjF TUKE
Description: Award on the occasion of the 65th anniversary of the founding of the faculty.

Hvizdoš Pavol
Grand Medal of the Faculty of Production Technologies TUKE
Awarded by: dean of FVT TUKE
Description: Award on the occasion of the 25th anniversary of the founding of the faculty.

2018:

Sedlák Richard
Competition of young scientists of SAS up to 35 years (award for 2nd place)
Awarded by: Presidium SAS

Dusza Ján
KOŠIČAN ROKA 2017 - Košická Sieň slávy (Košice Hall of Fame)
Awarded by: City of Košice
Description: Awarded for lifelong work and merits in the field of research and development of progressive ceramic materials not only in Slovakia but also in the world. He was nominated for this award by the Rector of the P. J. Šafárik University, P. Šovák.

Hvizdoš Pavol
Pamätná medaila - Commemorative Medal
Awarded by: Železiarne Podbrezová, Výskumno-vývojové centrum s.r.o
Description: Commemorative medal of the ŽP VVC on the occasion of the 10th anniversary of the company.

Šuľová Katarína
Competition for the best doctoral thesis at TUKE within the "Science and Technology Week in Slovakia 2018"
Awarded by: Technical University in Košice
Description: The best work from the scientific point of view

2019:

Sedlák Richard
Štefan Schwarz Support Fund grant 2019
Awarded by: Presidium SAS

Shepa Ivan
The best scientific doctoral thesis at TUKE within the Science and Technology Week in Slovakia in 2019
Awarded by: Technical University in Košice

2020:

Birčáková Zuzana
Young scientists to under 35 competition
Awarded by: Presidum SAS
Description: 3rd place

Kovalčíková Alexandra, Múdra Erika, Shepa Ivan
SAS Award for popularization of science and social applications of science
Awarded by: Presidium SAS
Description: Awarded to: A. Kovalčíková, E. Múdra, I. Shepa, For the entertaining-educational series Fun First Science / Fun Natural Science intended for pupils in the 2nd to 4th year of primary schools.

Dusza Ján
Science and Technology Award 2020
Awarded by: MSVS SR (Ministry of Education)

Csanádi Tamás
Outstanding young scientist under the age of 35
Awarded by: Eset Science Award

2021:

Shepa Ivan
Award: Honorable mention of young scientists of SAS up to 35 years
Awarded by: Presidium SAS

Janovec Jozef
Plaque of STU
Awarded by: Slovenská technická univerzita v Bratislave
Description: Plaque of the STU given by the principal of STU since 1993 to individuals and institutions for exceptional merit in development of the Slovak Technical University in Bratislava, and for contribution to education and science.

Varcholová Dagmara
Best PhD work at TU KE 2021
Awarded by: Technical University Košice

Dusza Ján
Award: Outstanding scientist in Slovakia
Awarded by: ESET Science Award

2.4. Research grants and other funding resources

(List type of project, title, grant number, duration, total funding and funding for the institute, responsible person in the institute and his/her status in the project, e.g. coordinator "C", work package leader "W", investigator "I". Add information on the projects which are interdisciplinary, and also on the joint projects with several participating SAS institutes)

- ## International projects

2.4.1. List of major projects of Framework Programmes of the EU (which pilar), NATO, COST, etc.

Program: COST
1)

Title of the project:	**Electrospun Nano-fibres for bio inspired composite materials and innovative industrial applications**
Slovak title:	Nanovlákna pre kompozitné materiály a inovatívne aplikácie

Grant number:	Cost MP 1206
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	prof. RNDr. Ján Dusza, DrSc. - **C**
Co-organisation:	-
Duration of the project:	1.10.2013 / 30.9.2017
Financial support:	
2016:	EÚ: 3500 €
2017:	EÚ: 1313 €

2)

Title of the project:	**Solutions for Critical Raw Materials Under Extreme Conditions**
Slovak title:	Kritické suroviny pri extrémnych podmienkach
Grant number:	CA15102
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	doc. RNDr. Pavol Hvizdoš, DrSc. - **W**
Co-organisation:	Universita Politecnica delle Marche, Ancona, Italy
Duration of the project:	17.11.2015 / 30.3.2020
Financial support:	
2016:	EÚ: 2917 €
2017:	EÚ: 3150 €
2018:	SAS-MVTS: 4480 €
2019:	SAS-MVTS: 3797 €
2020:	SAS-MVTS: 860 €

3)

Title of the project:	**Advanced fibre laser and coherent source as tools for society manufacturing and life science - The surface microstructure modification of steels via the fiber laser**
Slovak title:	Pokročilý vláknový laser a koherentný zdroj ako nástroje pre spoločnosť, priemyselnú výrobu a vedu o živote - Modifikácia povrchovej mikroštruktúry ocele prostredníctvom vláknového lasera
Grant number:	COST MP 1401
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	Mgr. Ivan Petryshynets, PhD. - **W**
Co-organisation:	Swansea University
Duration of the project:	10.12.2014 / 9.12.2018
Financial support:	
2016:	EÚ: 3500 €
2017:	EÚ: 3150 €
2018:	SAS - MVTS: 4480 €

Slovak Academy of Sciences - Academic Bilateral Agreements (MAD)

1)

Title of the project:	**Functional composites based on elastomer matrix and inorganic filler**
Slovak title:	Funkčné kompozity na báze elastomérnej matrice a anorganických plnív
Grant number:	MAD AV ČR 16-23
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	Ing. Radovan Bureš, CSc. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2016 / 31.12.2017
Financial support:	
2016:	SAV: 1198 €
2017:	SAV: 1183 €

2)

Title of the project:	**Compaction of soft magnetic powder materials with limited plastic deformation ability**
Slovak title:	Kompaktizácia magneticky mäkkých práškových materiálov s obmedzenou schopnosťou plastickej deformácie
Grant number:	MAD SAV - VAST
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	Ing. Radovan Bureš, CSc. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2018 / 31.12.2019
Financial support:	
2018:	SAV: 0 €
2019:	SAV: 0 €

3)

Title of the project:	**Syntesis and characterization of novel organic-inorganic polymeric hybrids for 3D printing**
Slovak title:	Príprava a charakterizácia pokročilých anorganicko-organických polymérnych hybridov pre 3D tlač
Grant number:	MAD AV ČR 18-26
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	Ing. Radovan Bureš, CSc. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2018 / 31.12.2021
Financial support:	
2018:	SAS - MVTS: 1178 €
2019:	SAS - MVTS: 660 €
2020:	SAS - MVTS: 0 €
2021:	SAS - MVTS: 0 €

4)

Title of the project:	**Modeling of phase diagrams of systems with boron**
Slovak title:	Modelovanie fázových diagramov systémov s bórom
Grant number:	MAD AV ĆR 15-11
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	RNDr. Viera Homolová, PhD. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2015 / 31.12.2017
Financial support:	
2016:	SAV: 1012 €
2017:	SAV: 1039 €

5)

Title of the project:	**Progressisve methods for treatment of the functional and mechanical properties of powder materials**
Slovak title:	Progresívne metódy úpravy funkčných a mechanických vlastností práškových materiálov
Grant number:	MAD AV ĆR 18-13
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	RNDr. Vladimír Kovaľ, PhD. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2018 / 31.12.2021
Financial support:	
2018:	SAS - MVTS: 1228 €
2019	SAS - MVTS: 1176 €
2020:	SAS - MVTS: 0 €
2021:	SAS - MVTS: 0 €

6)

Title of the project:	**Structural PM steels containing alloying elements with high affinity for oxygen sintered in atmosphere with different chemical composition**
Slovak title:	Konštrukčné PM ocele obsahujúce legujúce prvky s vysokou afinitou ku kyslíku spekané v atmosférach s rôznym chemickým zložením
Grant number:	No. 22
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	RNDr. Miriam Kupková, CSc. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2016 / 31.12.2018
Financial support:	
2016:	SAV: 1198 €
2017:	SAV: 0 €
2018:	SAV: 0 €

7)

Title of the project:	**Preparation of fiber lasers with a core from transparent ceamics and their use for laser surface modificaion of materials**
Slovak title:	Príprava vláknových laserov s jadrom z transparentnej keramiky a ich využitie na laserovú povrchovú modifikáciu materiálov
Grant number:	AV ČR -16-17
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	Ing. Viktor Puchý, PhD. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2016 / 31.12.2017
Financial support:	
2016:	SAV: 708 €
2017:	SAV: 722 €

8)

Title of the project:	**Preparation and characterization of soft magnetic high entropy alloys**
Slovak title:	Príprava a charakterizácia magneticky mäkkých zliatin s vysokou entropiou
Grant number:	MAD SAV-AVČR 15-08
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	RNDr. Magdaléna Strečková, PhD. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2015 / 31.12.2017
Financial support:	
2016:	SAV: 1198 €
2017:	SAV: 1183 €

9)

Title of the project:	**Low temperature electrohydrodynamic techniques used for preparation of bioceramic coatings**
Slovak title:	Nízkoteplotné elektrohydrodynamické metódy na prípravu biokeramických povlakov
Grant number:	MAD
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	RNDr. Tibor Sopčák, PhD. - **C**
Co-organisation:	Ústav materiálového výskumu SAV
Duration of the project:	1.1.2019 / 31.12.2021
Financial support:	
2019:	SAV: 0 €
2020:	SAV: 0 €
2021:	SAV: 0 €

Programs: Bilateral, multilateral, others

13)

Title of the project:	**Pulsating water jet as an orthopaedic technique**
Slovak title:	Pulzujúci vodný lúč ako ortopedická technika
Grant number:	15_PA07-C1
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	doc. RNDr. Pavol Hvizdoš, DrSc. - **W**
Co-organisation:	Ústav Geoniky AV ČR
Duration of the project:	1.4.2015 / 31.3.2016
Financial support:	
2016:	EÚ: 210 €

14)

Title of the project:	**Development of novel multifunctional materials for next generation magnetoelectric sensors and data storage devices**
Slovak title:	Vývoj nových multifunkčných materiálov pre magnetoelektrické senzory a úložiska digitálnych dát budúcej generácie
Grant number:	APVV-SK-CN-2017-0004
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	RNDr. Vladimír Kovaľ, PhD. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.1.2018 / 31.12.2019
Financial support:	
2018:	APVV: 3342 €
2019:	APVV: 3555 €

15)

Title of the project:	**The wear resistance improvement of tool steels surface via the laser hardening in combination with deep cryogenic treatment**
Slovak title:	Zlepšenie oteruvzdornosti povrchu nástrojových ocelí pomocou laserového kalenia v kombinácii s hlbokým kryogénnym spracovaním
Grant number:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	Mgr. Ivan Petryshynets, PhD. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	6.4.2017 / 31.12.2019
Financial support:	
2017:	EÚ: 0 €
2018:	SAS: 162 €
2019:	0

16)

Title of the project:	**Preparation of soft magnetic composites for infustrial application**
Slovak title:	Príprava magneticky mäkkých kompozitov pre priemysel
Grant number:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	RNDr. Magdaléna Strečková, PhD. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.9.2017 / 31.8.2020
Financial support:	
2017:	WŰRTH: 1346 €
2018:	WŰRTH: 39052 €
2019:	WŰRTH: 53086 €
2020:	WŰRTH: 35948 €

17)

Title of the project:	**ERC starting grant**
Slovak title:	ERC začínajúci projekt
Grant number:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project::	MSc. Tamás Csanádi, PhD. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.1.2020 / 30.10.2020
Financial support:	
2020:	SAV-MVTS: 6702 €

Program: International Visegrad Found (IVF)

18)

Title of the project:	**Development of advanced magnesium alloys for multifunctional applications in extreme environments**
Slovak title:	Vývoj pokročilých horčíkových zliatin pre multuifunkčné aplikácie v extrémnych prostrediach
Grant number:	JP39421
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	doc. RNDr. František Lofaj, DrSc. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.11.2021 / 31.10.2024
Financial support:	
2021:	0 €

Program: Others

25)

Title of the project:	**Strengthening and plasticity of high-entropy ultra-high temperature carbides**
Slovak title:	Spevnenie a plasticita vysokoentropických ultra vysokoteplotných karbidov
Grant number:	H2020-MSCA-IF
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	MSc. Tamás Csanádi, PhD. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.7.2021 / 30.6.2024
Financial support:	
2021:	SAV: 12000 €

Program: Mobility

26)

Title of the project:	**Preparation of BZT ceramic with conventional and pulse electric current sintering technique**
Slovak title:	Príprava BZT keramiky konvenčným spekaním a spekaním pomocou pulzného elektrického prúdu
Grant number:	SAV-SAVU-21-01 (SASA-SAS-21-01)
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	Ing. Viktor Puchý, PhD. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.1.2021 / 31.12.2022
Financial support:	
2021:	SAV: 1228 €

Program: SAS-UPJŠ ERC Visiting Felloship Grants

27)

Title of the project:	**Nanomechanics: The way to hard and demage tolerant high entropy ceramics**
Slovak title:	Nanomechanika: Cesta k tvrdej a voči poškodeniu odolnej keramike s vysokou entropiou
Grant number:	SAS-UPJS-ERC/2021/1229.C/1
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	prof.RNDr. Ján DUsza, DrSc. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.8.2021 / 31.8.2021
Financial support:	
2021:	SAV: 952 €

Add information on your activities in international networks

- **National projects, incl. international projects with only national funding**

2.4.2. List of ERA-NET projects funded from SAS budget

Program: ERANET

1)

Title of the project:	**Graphene-ceramic composites for tribological application in aqueous environments**
Slovak title:	Kompozity keramika-grafénové platničky pre využitie v tribologických systémoch pracujúcich vo vodnom prostredí
Grant number:	M-ERA.NET
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	prof. RNDr. Ján Dusza, DrSc. - **W**
Co-organisation:	Andreas Kailer, Prof.
Duration of the project:	1.9.2014 / 31.8.2017
Financial support:	
2016:	M-ERA.NET: 18500 €
2017:	M-ERA.NET: 14167 €

2)

Title of the project:	**Innovative Ni-Cr-Re coatings with enhanced corrosion and erosion resistance for high temperature applications in power generation industry**
Slovak title:	Inovatívne Ni-Cr-Re povlaky so zvýšenou odolnosťou voči korózii a erózii pre vysokoteplotné aplikácie v energetike
Grant number:	M-ERA.NET (H2020)
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	prof. RNDr. Ján Dusza, DrSc. - **W**
Co-organisation:	Institute of Electronic Materials Technology, Poland
Duration of the project:	1.9.2017 / 31.8.2020
Financial support:	
2017:	M-ERA.NET: 6250 €
2018:	SAV – MVTS: 25000 €
2019:	SAV – MVTS: 25000 €
2020:	SAV – MVTS: 18750 €

3)

Title of the project:	**Multifunctional Ceramic/Graphene Thick Coatings for New Emerging Application**
Slovak title:	Multifunkčné hrubé povlaky keramika-grafén pre perspektívne aplikácie
Grant number:	FLg-ETA II Joint Transnational Call (JTC 2017)
Acronym:	
Type of project/ Program:	

Responsible person in the organisation and his/her status in the project:	prof. RNDr. Ján Dusza, DrSc. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.1.2018 / 31.12.2020
Financial support:	
2018:	SAV MVTS: 15000 €
2019:	SAV MVTS: 15000 €
2020:	SAV MVTS: 15000 €

4)

Title of the project:	**Durable ceramics composites with superhard particles for wear-resistant cutting tools**
Slovak title:	Odolné keramické kompozity so supertvrdými časticami pre obrábacie nástroje so zvýšenou odolnosťou voči opotrebeniu
Grant number:	M-ERA.NET Call 2017
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	prof. RNDr. Ján Dusza, DrSc. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.7.2018 / 30.6.2021
Financial support:	
2018:	SAV – MVTS: 8333 €
2019:	SAV – MVTS: 25000 €
2020:	SAV – MVTS: 25000 €
2021:	SAV – MVTS: 16667 €

5)

Title of the project:	**Leightweight nanocrystalline aluminium based material for space applications (modeling and technology verification**
Slovak title:	Materiál pre vesmírne aplikácie na báze ľahkého nanokryštalického hliníka (modelovanie a verifikácia technológie)
Grant number:	M-ERA.NET
Acronym:	
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	doc. RNDr. František Lofaj, DrSc. - **W**
Co-organisation:	Lodz University of Technology
Duration of the project:	1.10.2015 / 30.9.2016
Financial support:	
2016:	M-ERA.NET: 22500 €
2017:	M-ERA.NET: 22500 €

6)

Title of the project:	**Novel explosive welded corrosion resistant clad materials for geothermal plants**
Slovak title:	Nové, výbuchom zvárané vrstevnaté materiály určené pre geotermálne elektrárne
Grant number:	M-ERA.NET
Acronym:	
Type of project/ Program:	

Responsible person in the organisation and his/her status in the project:	doc. Ing. Karel Saksl, DrSc. - **W**
Co-organisation:	University Research Centre – Functional Materials, Warsaw University of Technology
Duration of the project:	1.9.2014 / 31.8.2017
Financial support:	
2016:	M-ERA.NET: 25000 €
2017:	M-ERA.NET: 16667 €

2.4.3. List of projects of the Slovak Research and Development Agency, APVV

Program: APVV

1)

Title of the project:	**Development of novel 3D materials for post lithium ion bateries with high energy density**
Slovak title:	Vývoj nových 3D materiálov pre post Li-iónové batérie s vysokou energetickou hustotou
Grant number:	APVV-20-0138
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	Ing. Beáta Ballóková, PhD. - **W**
Co-organisation:	Prírodovedecká fakulta Univerzita Pavla Jozefa Šafárika v Košiciach
Duration of the project:	1.7.2021 / 31.12.2024
Financial support:	
	2021: APVV - 18960 €

2)

Title of the project:	**Design of the structure and the functional properties of soft magnetic 3-d transitions metals based composites**
Slovak title:	Dizajn štruktúry a funkčných vlastností magneticky mäkkých kompozitných materiálov na báze 3-d prechodných kovov
Grant number:	APVV-15-0115
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	Ing. Radovan Bureš, CSc. - **W**
Co-organisation:	Prírodovedecká fakulta Univerzita Pavla Jozefa Šafárika v Košiciach
Duration of the project:	1.7.2016 / 31.12.2019
Financial support:	
	2016: APVV - 13762 €
	2017: APVV - 27432 €
	2018: APVV - 26638 €
	2019: APVV - 26501 €

3)

Title of the project:	**Functional properties of compacted composites based on magnetic particles with surface-modified properties**
Slovak title:	Funkčné vlastnosti kompaktovaných kompozitov na báze magnetických častíc s povrchovo modifikovanými vlastnosťami

Grant number:	APVV-20-0072
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	Ing. Radovan Bureš, CSc. - **W**
Co-organisation:	Prírodovedecká fakulta Univerzita Pavla Jozefa Šafárika v Košiciach
Duration of the project:	1.7.2021 / 30.6.2025
Financial support:	2021: APVV - 7900 €

4)

Title of the project:	**Ceramic materials for extreme operating conditions**
Slovak title:	Keramické materiály pre použitie v extrémnych podmienkach
Grant number:	APVV-15-0469
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	prof. RNDr. Ján Dusza, DrSc. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.7.2016 / 30.6.2020
Financial support:	2016: APVV - 23339 € 2017: APVV - 38902 € 2018: APVV - 34986 € 2019: APVV - 36380 € 2020: APVV - 23427 €

5)

Title of the project:	**Development of REBCO superconductors for biomedical applications**
Slovak title:	Vývoj REBCO supravodičov pre biomedicínske aplikácie
Grant number:	APVV-17-0625
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	(P. Diko) prof. RNDr. Ján Dusza, DrSc. - **W**
Co-organisation:	ÚEF SAV
Duration of the project:	1.8.2018 / 30.6.2022
Financial support:	2018: APVV - 1485 € 2019: APVV - 7015 € 2020: APVV - 5700 € 2021: APVV - 5700 €

6)

Title of the project:	**Development of refractory pyrochlore phases for high temperature applications of non-oxide ceramics**
Slovak title:	Vývoj žiaruvzdorných pyrochlórnych fáz pre vysokoteplotné aplikácie neoxidovej keramiky
Grant number:	APVV-17-0328
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status	prof. RNDr. Ján Dusza, DrSc. - **C**

in the project:
Co-organisation: ÚMV SAV
Duration of the project: 1.7.2018 / 30.6.2022
Financial support:

2018: APVV - 6660 €
2019: APVV - 21640 €
2020: APVV - 18500 €
2021: APVV - 18367 €

7)

Title of the project: **New high-entropy ceramic materials for advanced applications**

Slovak title: Nové vysokoentropické keramické materiály pre pokročilé aplikácie

Grant number: APVV-19-0497
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: prof. RNDr. Ján Dusza, DrSc.- **C**
Co-organisation: ÚMV SAV
Duration of the project: 1.8.2020 / 31.7.2022
Financial support:

2020: APVV - 20000 €
2021: APVV - 40581 €

8)

Title of the project: **Increasing the quality of cut-outs and effectiveness of cutting electric sheets**

Slovak title: Zvýšenie kvality výstrižkov a efektívnosti strihania elektroplechov

Grant number: APVV-14-0834
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: RNDr. Miroslav Džupon, PhD. - **W**
Co-organisation: Technická univerzita v Košiciach - Strojnícka fakulta
Duration of the project: 1.7.2015 / 30.6.2018
Financial support:

2016: APVV - 31565 €
2017: APVV - 21473 €
2018: APVV - 12434 €

9)

Title of the project: **Research on the impact of process innovation on lifespan of forestry machinery tools and components**

Slovak title: Výskum vplyvu inovácií postupov výroby na životnosť nástrojov a komponentov lesných mechanizmov

Grant number: APVV-16-0194
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: RNDr. Miroslav Džupon, PhD. - **W**
Co-organisation: Technická univerzita vo Zvolene
Duration of the project: 1.7.2017 / 31.12.2020
Financial support:

2017: APVV - 11762 €

2018: APVV - 33220 €
2019: APVV - 32733 €
2020: APVV - 23842 €

10)

Title of the project:	**The utilization of innovative technology for repair functional surfaces of mold casting dies for castings in automotive industry**
Slovak title:	Využitie inovatívnych technológií obnovy funkčných plôch foriem na výrobu odliatkov pre automobilový priemysel
Grant number:	APVV-16-0359
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	RNDr. Miroslav Džupon, PhD. - **W**
Co-organisation:	Technická univerzita v Košiciach - Strojnícka fakulta
Duration of the project:	1.7.2017 / 30.6.2020
Financial support:	2017: APVV - 12639 € 2018: APVV - 36502 € 2019: APVV - 35098 € 2020: APVV - 17084 €

11)

Title of the project:	**Increasing the efficiency of forming and joining parts of hybrid car bodies**
Slovak title:	Zvyšovanie efektívnosti lisovania a spájania dielov hybridných karosérií
Grant number:	APVV-17-0381
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	RNDr. Miroslav Džupon, PhD. - **W**
Co-organisation:	Technická univerzita v Košiciach - Strojnícka fakulta
Duration of the project:	1.7.2018 / 31.12.2021
Financial support:	2018: APVV - 11184 € 2019: APVV - 35773 € 2020: APVV - 31999 € 2021: APVV - 28312 €

12)

Title of the project:	**Innovative approaches to the restoration of functional surfaces by laser weld overlaying**
Slovak title:	Inovatívne prístupy pri obnove funkčných povrchov laserovým naváraním
Grant number:	APVV-20-0303
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	RNDr. Miroslav Džupon, PhD. - **W**
Co-organisation:	Technická univerzita v Košiciach - Strojnícka fakulta
Duration of the project:	1.7.2021 / 30.6.2024
Financial support:	2021: APVV - 12525 €

13)

Title of the project:	**Advancement of knowledge in area of advanced metallic materials by use of up-to-date theoretical, experimental, and technological procedures**
Slovak title:	Rozvoj poznatkovej bázy v oblasti pokročilých kovových materiálov s využitím moderných teoretických, experimentálnych a technologických postupov
Grant number:	APVV-15-0049
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	RNDr. Viera Homolová, PhD. - **W**
Co-organisation:	Slovenská technická univerzita v Bratislave
Duration of the project:	1.7.2016 / 30.6.2020
Financial support:	2016: APVV - 5250 € 2017: APVV - 14800 € 2018: APVV - 10200 € 2019: APVV - 12000 € 2020: APVV - 7750 €

14)

Title of the project:	**Advanced composite coatings for high temperature corrosion protection of metals**
Slovak title:	Kompozitné vrstvy pre vysokoteplotnú protikoróznu ochranu kovov
Grant number:	APVV-15-0014
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	(D. Galusek) doc. RNDr. Pavol Hvizdoš, DrSc. - **W**
Co-organisation:	ÚACH SAV
Duration of the project:	1.7.2016 / 30.6.2020
Financial support:	2016: APVV - 6455 € 2017: APVV - 16535 € 2018: APVV - 14410 € 2019: APVV - 14958 € 2020: APVV - 7643 €

15)

Title of the project:	**Development of SiC based conductive ceramics**
Slovak title:	Vývoj vodivej keramiky na báze SiC
Grant number:	APVV-0108-12
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	doc. RNDr. Pavol Hvizdoš, DrSc. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.10.2013 / 30.9.2017
Financial support:	2016: APVV - 32650 € 2017: APVV - 23388 €

16)

Title of the project:	**Research and development of energy saving hybrid bearing reducer with lowered wear rate for robotic equipment (for Industry 4.0)**
Slovak title:	Výskum a vývoj energeticky úsporného hybridného

ložiskového reduktora so zníženým opotrebením pre robotické zariadenia (pre Priemysel 4.0)
Grant number: APVV-18-0438
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: doc. RNDr. Pavol Hvizdoš, DrSc. - **C**
Co-organisation: ÚMV SAV
Duration of the project: 1.7.2019 / 30.6.2022
Financial support:

2019: APVV - 35760 €
2020: APVV - 90373 €
2021: APVV - 90373 €

17)
Title of the project: **Unconventional technology development of final processing of isotropic electrical steels**
Slovak title: Vývoj nekonvenčnej technológie finalného spracovania izotrópnych elektrotechnických ocelí
Grant number: APVV-15-0259
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: RNDr. František Kováč, CSc. - **C**
Co-organisation: ÚMV SAV
Duration of the project: 1.7.2016 / 30.6.2019
Financial support:

2016: APVV - 33634 €
2017: APVV - 66517 €
2018: APVV - 66430 €
2019: APVV - 31313 €

18)
Title of the project: **Development of high-alloy isotropic electrical steels for traction engines of electric vehicles**
Slovak title: Vývoj vysoko-legovaných izotrópnych elektro ocelí pre trakčné motory elektromobilov
Grant number: APVV-18-0207
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: RNDr. František Kováč, CSc. - **C**
Co-organisation: ÚMV SAV
Duration of the project: 1.7.2019 / 30.6.2022
Financial support:

2019: APVV - 34926 €
2020: APVV - 63785 €
2021: APVV - 64264 €

19)
Title of the project: **Sintered biodegradable metallic materials**
Slovak title: Spekané biologicky odbúrateľné kovové materiály
Grant number: APVV-16-0029
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: RNDr. Miriam Kupková, CSc. - **W**
Co-organisation: PF UPJŠ
Duration of the project: 1.7.2017 / 31.12.2020

Financial support:

2017: APVV - 9920 €
2018: APVV - 22474 €
2019: APVV - 23333 €
2020: APVV - 19394 €

20)

Title of the project:	**Degradable metallic biomaterials with controlled drug release**
Slovak title:	Degradovateľné kovové biomateriály s riadeným uvoľňovaním liečiv
Grant number:	APVV-20-0278
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	RNDr. Miriam Kupková, CSc. - **W**
Co-organisation:	PF UPJŠ
Duration of the project:	1.7.2021 / 31.12.2024
Financial support:	2021: APVV - 5555 €

21)

Title of the project:	**Silicon oxynitride-based photoluminecent ceramic materials**
Slovak title:	Fotoluminescenčné keramické materiály na báze oxynitridov kremíka
Grant number:	APVV-14-0385
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	(Z. Lenčéš) prof. RNDr. Ján Dusza, DrSc. - **W**
Co-organisation:	Ústav anorganickej chémie SAV
Duration of the project:	1.7.2015 / 30.6.2019
Financial support:	2016: APVV - 15582 € 2017: APVV - 15582 € 2018: APVV - 15582 € 2019: APVV - 6289 €

22)

Title of the project:	**Multicomponent nanocomposite coatings prepared by highly ionized deposition technologies**
Slovak title:	Multikomponentné nanokompozitné povlaky pripravené vysokoionizovanými depozičnými technológiami
Grant number:	APVV-14-0173
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	doc. RNDr. František Lofaj, DrSc. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.7.2015 / 29.6.2018
Financial support:	2016: APVV - 32352 € 2017: APVV - 30871 € 2018: APVV - 17309 €

23)

Title of the project:	**Chalcogenide glasses/netal nanoparticles nanocomposites for plasmonics**

Slovak title:	Nanokompozity pre plazmoniku na báze chalkogénnych skiel s kovovými nanočasticami
Grant number:	SK-UA-2013-0046
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	doc. RNDr. František Lofaj, DrSc. - **C**
Co-organisation:	
Duration of the project:	1.9.2015 / 31.12.2016
Financial support:	2016: APVV - 1544 €

24)

Title of the project:	**Multicomponent boride and nitride coatings for ultrahigh temperature applications**
Slovak title:	Multikomponentné boridové a nitridové PVD povlaky pre ultravysokoteplotné aplikácie
Grant number:	APVV-17-0320
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	doc. RNDr. František Lofaj, DrSc. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.8.2018 / 30.6.2021
Financial support:	2018: APVV - 7375 € 2019: APVV - 33178 € 2020: APVV - 31184 € 2021: APVV - 14037 €

25)

Title of the project:	**Novel glass and glass-ceramic rare-earth aluminates-based phosphors for energy-saving solid state lighting sources emitting white light (pc-WLEDs)**
Slovak title:	Nové sklené a sklokeramické fosfory na báze hlinitanov vzácnych zemín pre aplikácie v pevnolátkových energiu šetriacich svetelných zdrojoch vyžarujúcich biele svetlo pc-WLED diódy
Grant number:	APVV-17-0049
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	doc. RNDr. František Lofaj, DrSc. - **W**
Co-organisation:	Trenčianska univerzita A. Dubčeka
Duration of the project:	1.8.2018 / 31.7.2022
Financial support:	2018: APVV - 2636 € 2019: APVV - 15087€ 2020: APVV - 13168 € 2021: APVV - 10445 €

26)

Title of the project:	**Investigation of phenomena induced by electron beam and electromagnetic radiation in chalcogenide glasses**
Slovak title:	Štúdium procesov vyvolaných elektrónovým zväzkom a elektromagnetickým žiarením v chalkogenidových sklách
Grant number:	APVV-17-0059

Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: doc. RNDr. František Lofaj, DrSc. - **W**
Co-organisation: UPJŠ
Duration of the project: 1.8.2018 / 31.7.2022
Financial support:

2018: APVV - 5600 €
2019: APVV - 24410 €
2020: APVV - 21667 €
2021: APVV - 19796 €

27)

Title of the project: **Research of the coating/substrate interphase modification to increase hard coating adhesion**
Slovak title: Výskum modifikácie fázových rozhraní v systéme povlak/podložka na zvýšenie adhézie tvrdých povlakov
Grant number: APVV-15-0168
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: doc. RNDr. František Lofaj, DrSc. - **W**
Co-organisation: MTF STU Trnava
Duration of the project: 1.7.2016 / 30.6.2019
Financial support:

2016: APVV - 19032 €
2017: APVV - 33050 €
2018: APVV - 31271 €
2019: APVV - 16043 €

28)

Title of the project: **Injectable hybrid composite biocements**
Slovak title: Injektovateľné hybridné kompozitné biocementy
Grant number: APVV-17-0110
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: Ing. Ľubomír Medvecký, PhD. - **C**
Co-organisation: ÚMV SAV
Duration of the project: 1.8.2018 / 30.6.2021
Financial support:

2018: APVV - 22227 €
2019: APVV - 45934 €
2020: APVV - 51469 €
2021: APVV - 22167 €

29)

Title of the project: **Chorioallantoic membrane – in vivo model for study of biocompatibility of materials**
Slovak title: Chorioalantoická membrána – in vivo model pre štúdium biokompatibility materiálov
Grant number: APVV-20-0073
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: Ing. Ľubomír Medvecký, PhD. - **C**
Co-organisation: ÚVLaF Košice
Duration of the project: 1.7.2021 / 30.6.2025
Financial support:

2021: APVV - 12147 €

30)

Title of the project:	**Composite biomaterials with complex natural additives**
Slovak title:	Kompozitné biomateriály s komplexnými prírodnými aditívami
Grant number:	APVV-20-0184
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	Ing. Ľubomír Medvecký, PhD. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.7.2021 / 30.6.2024
Financial support:	2021: APVV - 29214 €

31)

Title of the project:	**Development of new bioresorbable alloys for intra-body implants**
Slovak title:	Vývoj nových bioresorbovateľných zliatin pre vnútrotelové implantáty
Grant number:	APVV-20-0068
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	Ing. Zuzana Molčanová, PhD. - **W**
Co-organisation:	PF UPJŠ Košice
Duration of the project:	1.7.2021 / 30.6.2024
Financial support:	2021: APVV - 12362 €

32)

Title of the project:	**Development of new generation joints of power electronics using nonsandard Sn-based alloys**
Slovak title:	Vývoj novej generácie spojov výkonovej elektroniky s použitím neštandardných zliatin na báze cínu
Grant number:	APVV-14-0085
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	doc. Ing. Karel Saksl, DrSc. - **W**
Co-organisation:	Technická univerzita Košice - Fakulta elektrotechniky a informatiky
Duration of the project:	1.7.2015 / 30.6.2018
Financial support:	2016: APVV - 18215 € 2017: APVV - 18215 € 2018: APVV - 8898 €

33)

Title of the project:	**Development equipment for efficient compression and storage of hydrogen using new metal hydride alloys**
Slovak title:	Vývoj zariadenia pre efektívnu kompresiu a uskladnenie vodíka pomocou nových metalhydridových zliatin
Grant number:	APVV-15-0202
Type of project/ Program:	APVV
Responsible person in the	

organisation and his/her status in the project: doc. Ing. Karel Saksl, DrSc. - **W**
Co-organisation: Technická univerzita v Košiciach
Duration of the project: 1.7.2016 / 30.6.2019
Financial support:

2016: APVV - 15123 €
2017: APVV - 25386 €
2018: APVV - 25186 €
2019: APVV - 13117 €

34)

Title of the project: **Development of new biodegradable metal alloys for medical and prothetic applications**
Slovak title: Vývoj nových biodegradovateľných kovových zliatin určených pre medicínske a protetické aplikácie
Grant number: APVV-17-0008
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: doc. Ing. Karel Saksl, DrSc. - **C**
Co-organisation: ÚMV SAV
Duration of the project: 1.8.2018 / 30.6.2021
Financial support:

2018: APVV - 11765 €
2019: APVV - 33164 €
2020: APVV - 25826 €
2021: APVV - 13357 €

35)

Title of the project: **Development and testing of respirators with efficient degradation of viruses by filters containing antiviral materials**
Slovak title: Vývoj a testovanie respirátorov s efektívnou degradáciou výrusov filtra s obsahom antivirotických materiálov
Grant number: PP-COVID-20-0025
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: doc. Ing. Karel Saksl, DrSc./ Ing. Beáta Ballóková, PhD. - **W**
Co-organisation: Strojnícka fakulta, Technická univerzita v Košiciach
Duration of the project: 16.9.2020 / 31.12.2021
Financial support:

2020: APVV - 2467 €
2021: APVV - 49997 €

36)

Title of the project: **Research and development of new high-entropy alloys for efficient hydrogen storage in energy applications**
Slovak title: Výskum a vývoj nových vysokoentropických zliatin určených na efektívne uskladnenie vodíka v energetických aplikáciách
Grant number: APVV-20-0205
Type of project/ Program: APVV
Responsible person in the organisation and his/her status in the project: doc. Ing. Karel Saksl, DrSc. - **C**
Co-organisation: ÚMV SAV
Duration of the project: 1.7.2021 / 30.6.2024

Financial support:
2021: APVV - 31986 €

37)

Title of the project:	**Electrochemical detection of viruses**
Slovak title:	Elektrochemická detekcia vírusov
Grant number:	PP-COVID-20-0036
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	RNDr. Magdaléna Strečková, PhD. - **W**
Co-organisation:	UPJŠ v Košiciach
Duration of the project:	16.9.2020 / 31.12.2021
Financial support:	2020: APVV - 1350 € 2021: APVV - 10883 €

38)

Title of the project:	**Hydrogen evolution electrocatalysts for future electrolyser and fuel cells**
Slovak title:	Elektrokatalyzátory pre efektívnu produkciu vodíka pre budúce elektrolyzéry a palivové články
Grant number:	APVV-20-0299
Type of project/ Program:	APVV
Responsible person in the organisation and his/her status in the project:	RNDr. Magdaléna Strečková, PhD. - **C**
Co-organisation:	ÚMV SAV
Duration of the project:	1.7.2021 / 30.6.2025
Financial support:	2021: APVV - 19560 €

2.4.4. List of projects of the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education, VEGA (for funding specify only total sum obtained from all VEGA grants in particular year)

Program: VEGA

1)

Title of the project:	**Effect of intensive plastic deformations on microstructure and properties of advanced composite nanomaterial systems**
Slovak title:	Vplyv intenzívnych plastických deformácií na formovanie štruktúry a vlastnosti progresívnych kompozitných nanomateriálových sústav
Grant number:	2/0118/14
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Beáta Ballóková, PhD.
Duration of the project:	1.1.2014 / 31.12.2016
Financial support:	2016: SAS – 5623 €

2)

Title of the project:	**Effect of secondary phases on microstructure and mechanical properties of magnesium nanocomposite systems**

Slovak title:	Vplyv sekundárnych častíc na mikroštruktúru a mechanické vlastnosti horčíkových nanokompozitných sústav
Grant number:	2/0080/17
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Beáta Ballóková, PhD.
Duration of the project:	1.1.2017 / 31.12.2019
Financial support:	2017: SAS – 5852 € 2018: SAS – 7014 € 2019: SAS – 8004 €

3)

Title of the project:	**Preparation of hybrid composites and characterization of structure and magnetic properties at a wider temperature range**
Slovak title:	Príprava hybridných kompozitných materiálov a charakterizácia štruktúry a magnetických vlastností v širšom intervale teplôt
Grant number:	1/0225/20
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Zuzana Birčáková, PhD.
Duration of the project:	1.1.2020 / 31.12.2023
Financial support:	2020: SAS – 730 € 2021: SAS – 698 €

4)

Title of the project:	**Phase transformation in sol-gel R1/3(Nb, Ta)O3 ceramics and thin films based on rare earth elements**
Slovak title:	Fázové transformácie v sol-gel R1/3(Nb, Ta)O3 keramike a tenkých filmoch na báze prvkov vzácnych zemín
Grant number:	2/0041/14
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Helena Bruncková, PhD.
Duration of the project:	1.1.2014 / 31.12.2016
Financial support:	2016: SAS – 4921 €

5)

Title of the project:	**Effect of lanthanides on structure and nanomechanical properties of pyrochlore polymorphic Ln(Nb, Ta)O4 thin films prepared by sol-gel process**
Slovak title:	Vplyv lantanoidov na štruktúru a nanomechanické vlastnosti pyrochlórových polymorfných Ln(Nb, Ta)O4 tenkých filmov pripravených sol-gel procesom
Grant number:	2/0036/17
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Helena Bruncková, PhD.
Duration of the project:	1.1.2017 / 31.12.2019

Financial support:	2017: SAS – 3394 € 2018: SAS - 3544 € 2019: SAS – 3738 €

6)

Title of the project:	**Preparation and characterization of porous EuTbGd-MOF thin films for luminescent sensors**
Slovak title:	Príprava a charakterizácia pórovitých EuTbGd-MOF tenkých filmov pre luminiscenčné senzory
Grant number:	2/0037/20
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Helena Bruncková, PhD.
Duration of the project:	1.1.2020 / 31.12.2022
Financial support:	2020: SAS – 3842 € 2021: SAS – 3266 €

7)

Title of the project:	**Microstructure development and properties of functional composites based on progressive soft magnetic alloys**
Slovak title:	Vývoj mikroštruktúry a vlastnosti funkčných kompozitov založených na progresívnych magneticky mäkkých zliatinách
Grant number:	2/0185/15
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Radovan Bureš, CSc.
Duration of the project:	1.1.2015 / 31.12.2017
Financial support:	2016: SAS – 9491 € 2017: SAS – 7776 €

8)

Title of the project:	**Investigation of the progressive powder processing methods designated for fabrication of the soft magnetic composite**
Slovak title:	Výskum progresívnych metód úpravy práškových zliatin určených na prípravu magneticky mäkkých kompozitov
Grant number:	2/0108/18
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Radovan Bureš, CSc.
Duration of the project:	1.1.2018 / 31.12.2020
Financial support:	2018: SAS – 8857 € 2019: SAS – 7474 € 2020: SAS – 5440 €

9)

Title of the project:	**Influence of microwave radiation on the structure and properties of powder functional materials**
Slovak title:	Vplyv mikrovlnného žiarenia na štruktúru a vlastnosti práškových funkčných materiálov
Grant number:	2/0029/21
Type of project/ Program:	VEGA
Responsible person in the	

organisation and his/her status in the project:	Ing. Radovan Bureš, CSc.
Duration of the project:	1.1.2021 / 31.12.2023
Financial support:	2021: SAS – 8534 €

10)

Title of the project:	**Nanomechanical testing and deformability of high-entropy ultra-high temperature ceramics**
Slovak title:	Nanomechanické skúšanie a deformovateľnosť vysokoentropických ultravysokoteplotných keramických materiálov
Grant number:	2/0174/21
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	MSc. Tamás Csanádi, PhD..
Duration of the project:	1.1.2021 / 31.12.2023
Financial support:	2021: SAS – 8165 €

11)

Title of the project:	**Deformation and fracture properties of ceramic materials in micro/nano scale**
Slovak title:	Deformačné a lomové vlastnosti keramických materiálov na nano a mikro úrovni
Grant number:	2/0163/16
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	prof. RNDr. Ján Dusza, DrSc.
Duration of the project:	1.1.2016 / 31.12.2018
Financial support:	2016: SAS – 10540 € 2017: SAS – 13252 € 2018: SAS – 12178 €

12)

Title of the project:	**Re-evaluation of the effect of intermetallic phase on embrittling processes of creep-resistant steels**
Slovak title:	Prehodnotenie vplyvu intermetalickej fázy na procesy krehnutia žiarupevných ocelí
Grant number:	2/0062/19
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Ladislav Falat, PhD.
Duration of the project:	1.1.2019 / 31.12.2021
Financial support:	2019: SAS – 5295 € 2020: SAS – 5121 € 2021: SAS – 3859 €

13)

Title of the project:	**Thermodynamic analysis and modelling of phase diagram for Fe-B-Mn ternary system and verification database for thermodynamic calculations of complex systems by experimental analysis of Fe-B-X-Y (X,Y=V, Cr, C, Mn) alloys**
Slovak title:	Termodynamická analýza a modelovanie fázového diagramu ternárneho systému Fe-B-Mn a verifikácia databázy pre termodynamické výpočty komplexných

systémov experimentálnou analýzou zliatin typu Fe-B-X-Y (X, Y=V, Cr, C, Mn)

Grant number: 2/0153/15
Type of project/ Program: VEGA
Responsible person in the organisation and his/her status in the project: RNDr. Viera Homolová, PhD.
Duration of the project: 1.1.2015 / 31.12.2017
Financial support: 2016: SAS – 6677 €
2017: SAS – 4240 €

14)

Title of the project: **Thermodynamic modelling of the B-Fe-W ternary system and extrapolation of ternary data for thermodynamic calculations of poly-component alloy systems**
Slovak title: Termodynamické modelovanie ternárneho systému B-Fe-W a extrapolácia ternárnych dát pre termodynamické výpočty polykomponentných zliatinových systémov
Grant number: 2/0073/18
Type of project/ Program: VEGA
Responsible person in the organisation and his/her status in the project: RNDr. Viera Homolová, PhD.
Duration of the project: 1.1.2018 / 31.12.2020
Financial support: 2018: SAS – 8490 €
2019: SAS – 6618 €
2020: SAS – 6401 €

15)

Title of the project: **Modelling of phase diagram and thermodynamics properties of the systems for high temperature applications**
Slovak title: Modelovanie fázových diagramov a termodynamických vlastností systémov pre vysokoteplotné aplikácie
Grant number: 2/0038/21
Type of project/ Program: VEGA
Responsible person in the organisation and his/her status in the project: RNDr. Viera Homolová, PhD.
Duration of the project: 1.1.2021 / 31.12.2023
Financial support: 2021: SAS – 7051 €

16)

Title of the project: **Effect of continual and pulsating fluid jet on microstructure, properties and integrity on materials**
Slovak title: Vplyv kontinuálneho a pulzujúceho kvapalinového prúdu na mikroštruktúru, vlastnosti a integritu v materiáloch
Grant number: 1/0096/18
Type of project/ Program: VEGA
Responsible person in the organisation and his/her status in the project: doc. RNDr. Pavol Hvizdoš, DrrSc.
Duration of the project: 1.1.2018 / 31.12.2021
Financial support: 2018: SAS – 4974 €
2019: SAS – 6562 €

2020: SAS – 5972 €
2021: SAS – 6951 €

17)

Title of the project:	**Investigation of degradation processes of advanced nanocomposite mutilayers in melt of aluminum foundry alloys**
Slovak title:	Výskum procesov degradácie moderných nanokompozitných multivrstiev v tavenine zlievárenských zliatin hliníka
Grant number:	2/0061/14
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Dagmar Jakubéczyová, CSc.
Duration of the project:	1.1.2014 / 31.12.2016
Financial support:	2016: SAS – 5271 €

18)

Title of the project:	**Research of systems of duplex nanocomposite PVD coatings with laser - modified base material intended for pressure mould cast applications**
Slovak title:	Výskum systémov duplexných nanokompozitných PVD povlakov s laserom modifikovaným podkladovým materiálom pre aplikácie tlakového liatia kovov
Grant number:	2/0070/17
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Dagmar Jakubéczyová, CSc.
Duration of the project:	1.1.2017 / 31.12.2019
Financial support:	2017: SAS – 4524 € 2018: SAS – 5610 € 2019: SAS – 5917 €

19)

Title of the project:	**Design surface topography tools from the WC-Co applied PVD coating**
Slovak title:	Dizajn topografie povrchov nástrojov z WC-Co s aplikovanými PVD povlakmi
Grant number:	2/0070/20
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Dagmar Jakubéczyová, CSc.
Duration of the project:	1.1.2020 / 31.12.2022
Financial support:	2020 SAS – 5442 € 2021: SAS – 5048 €

20)

Title of the project:	**Influence of laser welding parameters on microstructure and properties of welded joints of advanced steels for automotive industry**
Slovak title:	Vplyv parametrov laserového zvárania na štruktúru a vlastnosti zvarových spojov moderných ocelí pre automobilový priemysel
Grant number:	2/0113/16
Type of project/ Program:	VEGA

Responsible person in the organisation and his/her status in the project:	Ing. Ján Kepič, PhD.
Duration of the project:	1.1.2016 / 31.12.2018
Financial support:	2016: SAS – 5589 € 2017: SAS – 6045 € 2018: SAS – 7013 €

21)

Title of the project:	**Prediction of weldasbility and formability for laser welded tailored blanks made of combined high strength steels with CAE support**
Slovak title:	Predikcia zvariteľnosti a lisovateľnosti kombinovaných laserom zváraných prístrihov z vysokopevných ocelí s podporou CAE systémov
Grant number:	2/0080/19
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Ján Kepič, PhD.
Duration of the project:	1.1.2019 / 31.12.2022
Financial support:	2019: SAS – 5839 € 2020: SAS – 4003 € 2021: SAS – 3712 €

22)

Title of the project:	**Modification of surface microstructure of tool steels by laser**
Slovak title:	Modifikácia povrchovej mikroštruktúry nástrojových ocelí laserom
Grant number:	2/0081/16
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. František Kováč, CSc.
Duration of the project:	1.1.2016 / 31.12.2018
Financial support:	2016: SAS – 10896 € 2017: SAS – 10957 € 2018: SAS – 17013 €

23)

Title of the project:	**Double-oriented electrical steels with high and isotropic magnetic induction**
Slovak title:	Textúrne dvojito orientované elektrotechnické ocele s vysokou, izotrópnou induikciou
Grant number:	2/0073/19
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. František Kováč, CSc.
Duration of the project:	1.1.2019 / 31.12.2021
Financial support:	2019: SAS – 6618 € 2020: SAS – 5602 € 2021: SAS – 4824 €

24)

Title of the project:	**Investigation of phase transitions induced in magnetoelectric ceramics by chemical substitution and temperature changes**

Slovak title:	Štúdium fázových prechodov indukovaných v keramických magnetoelektrikách chemickou substitúciou a teplotnými zmenami
Grant number:	2/0057/14
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Vladimír Kovaľ, PhD.
Duration of the project:	1.1.2014 / 31.12.2016
Financial support:	2016: SAS – 3514 €

25)

Title of the project:	**Multifunctional Aurivillius-type magnetoelectrics for advanced data storage and sensor applications**
Slovak title:	Multifunkčné keramické materiály Aurivilliového typu pre pokročilé magnetoelektrické pamäťové zariadenia a senzory
Grant number:	2/0059/17
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Vladimír Kovaľ, PhD.
Duration of the project:	1.1.2017 / 31.12.2019
Financial support:	2017: SAS – 1767 € 2018: SAS – 2213 € 2019: SAS – 2334 €

26)

Title of the project:	**Innovative approaches to research and development of novel ferroic materials by using complex impedance spectroscopy**
Slovak title:	Inovatívne postupy vo výskume a vývoji nových feroických materiálov s využitím komplexnej impedančnej spektroskopie
Grant number:	2/0038/20
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Vladimír Kovaľ, PhD.
Duration of the project:	1.1.2020 / 31.12.2022
Financial support:	2020: SAS – 1919 € 2021: SAS – 1780 €

27)

Title of the project:	**Influence of chemical composition and heat treatment on the oxidation resistance of advanced silicon carbide based ceramics**
Slovak title:	Vplyv chemického zloženia a tepelného spracovania na odolnosť voči oxidácii moderných keramických materiálov na báze karbidu kremičitého
Grant number:	2/0043/14
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Alexandra Kovalčíková, PhD.
Duration of the project:	1.1.2014 / 31.12.2016
Financial support:	2016: SAS - 4920€

28)

Title of the project:	**The influence of graphene platelets addition on tribological properties of ceramic composites based on carbides and borides**
Slovak title:	Vplyv grafénu na tribologické vlastnosti keramických materiálov na báze karbidov a boridov
Grant number:	2/0130/17
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Alexandra Kovalčíková, PhD.
Duration of the project:	1.1.2017 / 31.12.2019
Financial support:	2017: SAS – 14313 € 2018: SAS – 11071 € 2019: SAS – 9340 €

29)

Title of the project:	**High-temperature properties of diboride MeB2 (Me = Ti, Zr, Hf) ceramic composite materials**
Slovak title:	Vysokoteplotné vlastnosti boridových MeB2 (Me = Ti, Zr, Hf) keramických kompozitných materiálov
Grant number:	2/0118/20
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Alexandra Kovalčíková, PhD.
Duration of the project:	1.1.2020 / 31.12.2022
Financial support:	2020: SAS – 8399 € 2021: SAS – 9040 €

30)

Title of the project:	**Sintered biologically degradable materials based on the iron powders**
Slovak title:	Spekané biologicky odbúrateľné materiály na báze práškového železa
Grant number:	2/0100/15
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Miriam Kupková, CSc
Duration of the project:	1.1.2015 / 31.12.2017
Financial support:	2016: SAS – 5273 € 2017: SAS – 4242 €

31)

Title of the project:	**Nanomaterials and nanostructured layers with specific functionality**
Slovak title:	Nanomateriály a nanoštruktúrované vrstvy so špecifickou funkcionalitou
Grant number:	1/0074/17
Type of project/ Program:	VEGA - UPJŠ
Responsible person in the organisation and his/her status in the project:	RNDr. Miriam Kupková, CSc
Duration of the project:	1.1.2017 / 31.12.2020
Financial support:	2017: SAS – 882 €

2018: SAS – 1615 €
2019: SAS – 1680 €
2020: SAS – 1869 €

32)

Title of the project:	**Solid ionic conductors: preparation, properties and potential application in all-solid-state lithium batteries**
Slovak title:	Tuhé iónové vodiče: výroba, vlastnosti, perspektíva vyuyžitia v lítiových batériách s tuhým elektrolytom
Grant number:	2/0066/21
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Miriam Kupková, CSc
Duration of the project:	1.1.2021 / 31.12.2023
Financial support:	2021: SAS – 2134 €

33)

Title of the project:	**Application of innovative nanocatalysts and DFT simulations for efficient hydrogen production**
Slovak title:	Aplikácia inovatívnych nanokatalyzátorov a DFT simulácií pre efektívnu výrobu vodíka
Grant number:	1/0095/21
Type of project/ Program:	VEGA - UPJŠ
Responsible person in the organisation and his/her status in the project:	RNDr. Miriam Kupková, CSc
Duration of the project:	1.1.2021 / 31.12.2024
Financial support:	2021: SAS – 1171 €

34)

Title of the project:	**The effect of high plasma ionization on structure and mechanical properties of high energy pulsed PVD MeC and MeN (Me=Ti, Cr, W) based coatings**
Slovak title:	Vplyv stupňa ionizácie plazmy na štruktúru a mechanické vlastnosti MeC a MeN (Me=Ti, Cr, W) povlakov pripravovaných vysokoenergetickými pulznými PVD procesmi
Grant number:	2/0187/15
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Lenka Kvetková, PhD.
Duration of the project:	1.1.2015 / 31.12.2017
Financial support:	2016: SAS – 7380 € 2017: SAS – 8977 €

35)

Title of the project:	**Modeling of stress state during nanoindentation and mechanical loading in composite systems (MONACO*)***
Slovak title:	Modelovanie napäťových stavov pri nanoindentácii a mechanickom zaťažení v kompozitných systémoch
Grant number:	2/0098/14
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status	doc. RNDr. František Lofaj, DrSc.

in the project:	
Duration of the project:	1.1.2014 / 31.12.2016
Financial support:	2016: SAS – 8080 €

36)

Title of the project:	**Multicompoonent high entropy ceramic coatings prepared by ionized sputtering (HECC)**
Slovak title:	Viackomponentné keramické povlaky s vysokou entropiou pripravené iónovým naprašovaním
Grant number:	2/0017/19
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	doc. RNDr. František Lofaj, DrSc.
Duration of the project:	1.1.2019 / 31.12.2021
Financial support:	2019: SAS – 11288 € 2020: SAS – 9201 € 2021: SAS – 10392 €

37)

Title of the project:	**Hybrid composite systems with bioglass component**
Slovak title:	Hybridné kompozitné systémy s bioskelnou zložkou
Grant number:	2/0047/14
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Ľubomír Medvecký, PhD.
Duration of the project:	1.1.2014 / 31.12.2016
Financial support:	2016: SAS – 8437 €

38)

Title of the project:	**Biomimetically hardened hydrogel/calcium phosphate cements**
Slovak title:	Biomimeticky vytvrdzované hydrogél/kalcium fosfátové cementy
Grant number:	2/0047/17
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Ľubomír Medvecký, PhD.
Duration of the project:	1.1.2017 / 31.12.2019
Financial support:	2017: SAS – 8484 € 2018: SAS – 8860 € 2019: SAS – 9344 €

39)

Title of the project:	**Preparation and development of nanocrystalline Cu-based composite for high-temperature applications**
Slovak title:	Príprava a vývoj nanokryštalického kompozitu na báze Cu určeného pre vysokoteplotné aplikácie
Grant number:	2/0141/19
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	doc. Ing. Ondrej Milkovič, PhD.
Duration of the project:	1.1.2019 / 31.12.2021
Financial support:	2019: SAS – 9952 €

2020: SAS – 10628 €
2021: SAS – 10045 €

40)

Title of the project:	**Development of nano/microfibers based on metal oxides by needle-less electrospinning for special technical applications**
Slovak title:	Vývoj nano/mikrovlákien na báze oxidov kovov metódou elektrostatického zvlákňovania pre špeciálne technické aplikácie
Grant number:	2/0099/18
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Erika Múdra, PhD.
Duration of the project:	1.1.2018 / 31.12.2020
Financial support:	2018: SAS – 4722 € 2019: SAS – 4981 € 2020: SAS – 7040 €

41)

Title of the project:	**The modification of domain structure of silicon electrotechnical steels by laser beam**
Slovak title:	Modifikácia doménovej štruktúry kremíkových elektrotechnických ocelí pomocou laserového žiarenia
Grant number:	2/0120/15
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Mgr. Ivan Petryshynets, PhD.
Duration of the project:	1.1.2015 / 31.12.2017
Financial support:	2016: SAS – 3866 € 2017: SAS – 3888 €

42)

Title of the project:	**The microstructural and substructural design of electrical steels for demanding applications in the electrical cars drives**
Slovak title:	Dizajn mikroštruktúry a subštruktúry elektroocelí pre náročné aplikácie v pohonoch elektromobilov
Grant number:	2/0066/18
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Mgr. Ivan Petryshynets, PhD.
Duration of the project:	1.1.2018 / 31.12.2020
Financial support:	2018: SAS – 4060 € 2019: SAS – 4282 € 2020: SAS – 4401 €

43)

Title of the project:	**Unconventional thermo-mechanical technology development of final processing of isotropoic electrical steels**
Slovak title:	Vývoj nekonvenčného termo-mechanického postupu finálneho spracovania izotrópnych elektrotechnických ocelí
Grant number:	2/0106/21
Type of project/ Program:	VEGA
Responsible person in the	

organisation and his/her status in the project:	Mgr. Ivan Petryshynets, PhD.
Duration of the project:	1.1.2021 / 31.12.2023
Financial support:	2021: SAS – 7051 €

44)

Title of the project:	**Development of progressive dispersion – reinforced metal matrix composites prepared by pulsed electric current sintering**
Slovak title:	Vývoj progresívnych disperzne spevnených kompozitov s kovovou matricou pripravených spekaním pomocou pulzného elektrického prúdu
Grant number:	2/0101/20
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Viktor Puchý, PhD.
Duration of the project:	1.1.2020 / 31.12.2022
Financial support:	2020: SAS – 3840 € 2021: SAS – 4025 €

45)

Title of the project:	**Effect of chemical composition and microstructure on the susceptibility of dual phase steels to hydrogen embrittlement**
Slovak title:	Účinok chemického zloženia a mikroštruktúry na náchylnosť dvojfázových ocelí ku vodíkovému krehnutiu
Grant number:	2/0176/15
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	doc. Ing. Gejza Rosenberg, CSc.
Duration of the project:	1.1.2015 / 31.12.2017
Financial support:	2016: SAS – 4780 € 2017: SAS – 3110 €

46)

Title of the project:	**Development and research on metallic glasses and nanocrystalline materials**
Slovak title:	Vývoj a výskum kovových skiel a nanokryštalických materiálov
Grant number:	2/0021/16
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	doc. Ing. Karel Saksl, DrSc.€
Duration of the project:	1.1.2016 / 31.12.2018
Financial support:	2016: SAS – 13920 € 2017: SAS – 18241 € 2018: SAS – 15505 €

47)

Title of the project:	**Development of new biodegradable metal alloys for medical applications**
Slovak title:	Vývoj nových biodegradovateľných kovových zliatin určených pre medicínske aplikácie
Grant number:	2/0013/19
Type of project/ Program:	VEGA
Responsible person in the	

organisation and his/her status in the project:	doc. Ing. Karel Saksl, DrSc.
Duration of the project:	1.1.2019 / 31.12.2021
Financial support:	2019: SAS – 11681 € 2020: SAS – 15607 € 2021: SAS – 15590 €

48)

Title of the project:	**Development of high-temperature composite materials based on borides and carbides with the addition of graphene platelets prepared by progressive sintering methods**
Slovak title:	Vývoj vysokoteplotných materiálov na báze boridov a karbidov s prídavkom grafénových platničiek pripravených progresívnymi metódami spekania
Grant number:	2/0175/21
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Richard Sedlák, PhD.
Duration of the project:	1.1.2021 / 31.12.2023
Financial support:	2021: SAS – 9040 €

49)

Title of the project:	**Composite systems based on bioelastomers and bioactive phases**
Slovak title:	Kompozitné systémy na báze bioelastomerov a bioaktívnych fáz
Grant number:	2/0034/21
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Tibor Sopčák, PhD.
Duration of the project:	1.1.2021 / 31.12.2023
Financial support:	2021: SAS – 4082 €

50)

Title of the project:	**Lowdimensional systems in electrode and magnetic materials potentially applied in green technologies**
Slovak title:	Nízkorozmerné systémy pre elektródové a magnetické materiály využité v zelených technológiách
Grant number:	2/0079/17
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Magdaléna Strečková, PhD.
Duration of the project:	1.1.2017 / 31.12.2019
Financial support:	2017: SAS – 2827 € 2018: SAS – 7381 € 2019: SAS – 5838 €

51)

Title of the project:	**Development of electrode materials based carbon fibers doped with metal phosphides for electrocatalysis of hydrogen evolution reaction**
Slovak title:	Vývoj elektródového materiálu na báze uhlíkových vlákien dopovaných fosfidmi kovov pre elektrokatalýzu vodíka
Grant number:	2/0036/20

Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Magdaléna Strečková, PhD.
Duration of the project:	1.1.2020 / 31.12.2022
Financial support:	2020: SAS – 4800 € 2021: SAS – 6234 €

52)

Title of the project:	**Influence of the HAZ microstructure on degradation of modified 9Cr steels**
Slovak title:	Vplyv mikroštruktúry TOO v modifikovaných 9Cr oceliach na porušovanie
Grant number:	2/0151/16
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	RNDr. Peter Ševc, PhD.
Duration of the project:	1.1.2016 / 31.12.2018
Financial support:	2016: SAS – 4568 € 2017: SAS – 5300 € 2018: SAS – 4798 €

53)

Title of the project:	**Composite magnesium-calcium phosphate biocements with addition of colloidal silicon dioxide**
Slovak title:	Kompozitné horčíkovo-vápenato fosforečné biocementy s prídavkom koloidného oxidu kremičitého
Grant number:	2/0069/20
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Ing. Radoslava Štulajterová, PhD.
Duration of the project:	1.1.2020 / 31.12.2022
Financial support:	2020: SAS – 5762 € 2021: SAS – 3118 €

54)

Title of the project:	**The effect of the ceramic/carbon nanostructures interface on the mechanical properties of ceramic matrix composites**
Slovak title:	Vplyv rozhrania keramika-uhlíkové nanoštruktúry na mechanické vlastnosti kompozitov s keramickou matricou
Grant number:	2/0189/15
Type of project/ Program:	VEGA
Responsible person in the organisation and his/her status in the project:	Mgr. Monika Tatarková, PhD.
Duration of the project:	1.1.2015 / 31.12.2017
Financial support:	2016: SAS – 8786 € 2017: SAS – 8306 €

55)

Title of the project:	**Study of shape memory effect and related phenomena in ceramics**
Slovak title:	Štúdium javu tvarovej pamäti a príbuzných javov v keramických systémoch
Grant number:	2/0091/18
Type of project/ Program:	VEGA

Responsible person in the organisation and his/her status in the project:	Ing. Marek Vojtko, PhD.
Duration of the project:	1.1.2018 / 31.12.2020
Financial support:	2018: SAS – 5018 € 2019: SAS – 5093 € 2020: SAS – 5439 €

2.4.5. List of projects supported by EU Structural Funds

Title of the project:	**Advancement and support of R&D for „Centre for diagnostics and quality testing of materials" in the domains of the RIS3 SK**
Slovak title:	Rozvoj a podpora výskumno-vývojových aktivít centra pre testovanie kvality a diagnostiku materiálov v oblastiach špecializácie RIS3 SK
Grant number:	ITMS2014+313011W442
Type of project/ Program:	ŠF
Responsible person in the organisation and his/her status in the project:	prof. RNDr. Ján Dusza, DrSc.
Co-organisation:	Trenčianska univerzita A. Dubčeka, Trenčín
Duration of the project:	1.1.2019 / 30.6.2023
Financial support:	2021: 95237 €

2.4.6. List of other projects funded from national resources

Program: SPVV / science-technology projects

1)

Title of the project:	**Research of innovative forms treatment of bone defects by joining bioactive biomaterials and autologous growth factors**
Slovak title:	Výskum inovatívnych foriem liečenia kostných defektov prepojením bioaktívnych biomateriálov s autológnymi rastovými faktormi
Grant number:	
Type of project/ Program:	ŠPVV
Responsible person in the organisation and his/her status in the project:	Ing. Ľubomír Medvecký, PhD.
Co-organisation:	ÚMV SAV
Duration of the project:	15.12.2018 / 14.12.2021
Financial support:	2018: ŠPVV: 0 € 2019: ŠPVV: 20761 € 2020: ŠPVV: 21216 € 2021: ŠPVV: 26592 €

Program: Others

1)

Title of the project:	**Nanocomposite material for ballistic protection**
Slovak title:	Nanokompozitný materiál pre balistickú ochranu
Grant number:	

Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	Ing. Viktor Puchý, PhD.
Co-organisation:	ÚMV SAV
Duration of the project:	1.5.2019 / 31.8.2021
Financial support:	2019: other - 46360 € 2020: other - 45385 € 2021: other - 10965 €

Program: SASPRO

1)

Title of the project:	**Dual-phase high-entropy ultra high temperature ceramics**
Slovak title:	Dvojfázová vysokoentropická ultravysokoteplotná keramika
Grant number:	1152/01/01
Type of project/ Program:	SASPRO
Responsible person in the organisation and his/her status in the project:	Ing. Annamária Naughton-Duszová, PhD.
Co-organisation:	ÚMV SAV
Duration of the project:	1.10.2021 / 30.9.2024
Financial support:	2021: SAV: 14376 €

Program: MoRePro

1)

Title of the project:	**Development of technology for the manufacture of FeGa-based alloys for high-frequency devices**
Slovak title:	
Grant number:	19MRP0061
Type of project/ Program:	MoRePro
Responsible person in the organisation and his/her status in the project:	Dr. Vasily Milyutin
Co-organisation:	ÚMV SAV
Duration of the project:	15.10.2020 / 14.10.2023
Financial support:	2020: SAV: 3582 € 2021: SAV: 49493 €

Program: DoktoGrant

1)

Title of the project:	**Progressive methods of preparation of modified carbon fibers for efficient hydrogen development**
Slovak title:	Progresívne metódy prípravy modifikovaných uhlíkových vlákien pre efektívny vývoj vodíka
Grant number:	APP0088
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	Mgr.Mária Štelmáková (Hečková)
Co-organisation:	ÚMV SAV
Duration of the project:	1.1.2020 / 30.6.2021
Financial support:	2020: SAV - 1339 € 2021: ŠAV - 661 €

2.4.7. List of projects funded from private funds

2.4.8. List of projects funded from other competitive funds

2.5. PhD studies and educational activities

2.5.1. List of accredited programmes of doctoral studies, period of validity, source of funding

5.2.26 – Materials – study programme: Materials Science and Materials Engineering - until 2019
4.1.3 – Condensed matter physics and acoustics – study programme: Advanced materials – until 2019
Mechanical Engineering – study programme: Materials Science and Materials Engineering – since 2019
Physics – study programme: Advanced materials – since 2019
Mechanical engineering – study programme: Applied mechanich - since 2020
Electrical engineering – study programme: Biomedical engineering - since 2020
Mechanical engineering – study programme: Engineering technologies and materials - since 2020

2.5.2. Summary table on doctoral studies (number of internal/external PhD students at the end of the year; number of foreign PhD students, number of students who successfully completed their theses during the year, number of PhD students who quit the programme during the year)

PhD study	2016			2017			2018			2019			2020			2021		
Number of potential PhD supervisors	19			19			19			19			19			19		
PhD students	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	unumber, end of yea	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted
Internal total	12	4	1	12	4	0	16	3	1	15	2	1	13	2	2	14	2	0
from which foreign citizens	2	0	0	3	1	0	2	0	0	3	0	0	3	1	0	4	1	
External	2	0	0	2	1	0	4	0	0	4	0	0	3	0	1	4	0	0
Other supervised by the research employees of the institute	1	0	0	1	0	0	1	0	0	1	0	0	3	1	0	5	0	0

2.5.3. PhD carrier path – Information on the next career steps of the PhD graduates who received their degree from the institute

2016 – P. Hviščová (Kušnírová), T. Sopčák - *employed at the institute*,
2016 - D. Balga, P. Repovský
2017 - T. Csanádi, J. Szabó - *employed at the institute*,
2017 – D. Németh, Z.Pramuková (Vilčeková)
2018 – R. Sedlák, M. Fides - *employed at the institute*
2018 - P. Kurek
2019 – R. Džunda - *employed at the institute*
2019 – B. Petrov
2020 - I. Shepa, K. Kušnírová (Šuľová) - *employed at the institute*
2020 – M. Šulíková
2021 - I. Kirkovská, M. Štelmáková (Hečková)

2.5.4. Summary table on educational activities

Teaching	2016	2017	2018	2019	2020	2021
Lectures (hours/year)*	36	125	114	72	76	97
Practicum courses (hours/year)*	67	30	89	146	23	26
Supervised diploma and bachelor thesis (in total)	3	3	5	3	5	0
Members in PhD committees (in total)	9	11	7	10	4	5
Members in DrSc. committees (in total)	2	1	2	2	3	3
Members in university/faculty councils (in total)	2	2	2	6	6	7
Members in habilitation/inauguration committees (in total)	2	2	2	2	2	3

2.5.5. List of published university textbooks

2.5.6. Number of published academic course books

2.5.7. List of joint research laboratories/facilities with universities

Name of university/college and faculty: P.J. Šafárik University in Košice
Type of cooperation (joint work or other): Center of Excellence for Advanced Materials with Nano and Submicron Structure **(**Centrum excelentnosti progresívnych materiálov s nano a submikrónovou štruktúrou)
Start of cooperation: 2009
Focus: Project SF EU
Evaluation: A workplace with research and development infrastructure in the field of nanotechnologies and progressive materials with nano and submicron structure was established in Košice within the CE with the seat at the IMR SAS, in order to carry out top research within international cooperation in nanotechnologies and submicron structure and to support the transfer of acquired knowledge into practice. In addition to UPJŠ, CE partners are also IEP SAS and IGT SAS.

Name of university/college and faculty: P.J. Šafárik University in Košice
Type of cooperation (joint work or other): Joint Laboratory of Transmission Electron Microscopy (Spoločné laboratórium transmisnej elektrónovej mikroskopie)
Start of cooperation: 2011
Focus: teaching, joint lab
Evaluation: The JEOL 2100 F transmission electron microscope with a high resolution is operated in the premises of PF UPJŠ within this laboratory. IEP SAS and IGT SAS also participate in SLTEM activities in partnership. The joint laboratory is organizationally integrated into the organizational structure of the partners and is governed by its own statute.

Name of university/college and faculty: Technical university in Košice
Type of cooperation (joint work or other): A joint research and innovation platform for sustainable raw materials - Spoločná výskumno-inovačná platforma pre trvalo udržateľné surovinové zdroje
Start of cooperation: 2011
Focus: teaching, research and development, technology transfer
Evaluation: Coordinated activities aimed at integrating the research capacities of the university and participating SAS institutes, enabling effective implementation of research,

development and innovation activities in the field of raw material acquisition and processing and transfer of science and research results into practice in the form of specific innovation projects. The partners within the platform are the Faculty of BERG and the Faculty of Metallurgy of TU Košice, IGT SAS and IMR SAS.

Name of university/college and faculty: A. Dubček University in Trenčín
Type of cooperation (joint work or other): Centre of excellence for ceramics, glass and silicate materials - Centrum excelentnosti pre keramiku, sklo a silikátové materiály (CEKSIM)
Start of cooperation: 2013
Focus: teaching, joint lab
Evaluation: The CEKSIM Center of Excellence is a joint workplace of the partners: Alexander Dubček University of Trenčín in Trenčín, the Institute of Inorganic Chemistry of the Slovak Academy of Sciences in Bratislava and the Institute of Materials Research of the Slovak Academy of Sciences in Košice.
The department has several specialized laboratories equipped with state-of-the-art instrumentation and modern information and communication technology, which enable the solution of basic and applied research tasks, as well as experimental development in the preparation, characterization and diagnostics of new types of materials and their transfer to modern technologies. The target group in terms of cooperation with industry is the defense, engineering, automotive and especially the glass industry. The established laboratories of electron microscopy, X-ray diffraction, thermal analysis, ceramographic and furnace laboratories, as well as the laboratory of molecular spectroscopy serve not only for excellent research of researchers in the field, but also for training domestic and foreign doctoral students.
Also in connection with the activities of the center, there is intensive cooperation between the participating partners in the field of joint projects, in the use of methodologies, as well as in formal and non-formal education of students, doctoral students and post-docs.

Name of university/college and faculty: Faculty of Mathematics, Physics and Informatics, Comenius University
Type of cooperation (joint work or other): joint project APVV-14-0173
Start of cooperation: 2015
Focus: multicomponent nanocomposite coatings
Evaluation: collaboration, joint publications

Name of university/college and faculty: University of veterinary medicine and pharmacy in Košice
Type of cooperation (joint work or other): VEGA and APVV projects
Start of cooperation: 2013
Focus: new biomaterials, preparation, testing, patent pending
Evaluation: joint publications and 1 external PhD student

Name of university/college and faculty: Material technology Faculty of STU in Trnava
Type of cooperation (joint work or other): joint project APVV-15-0168
Start of cooperation: 2016
Focus: modification of phase boundaries
Evaluation: collaboration joint publications

Name of university/college and faculty: Faculty of production technologies TUKE in Prešov
Type of cooperation (joint work or other): collaboration in the water jet technology
Start of cooperation: 2012
Focus: materials influenced by water jet machining
Evaluation: collaboration joint publications

Name of university/college and faculty: P.J. Šafárik University in Košice
Type of cooperation (joint work or other): joint APVV and VEGA projects
Start of cooperation: 2017

Focus: Preparation and characterization of nanostructured functional layers, biodegradable metallic PM materials, magnetically soft PM
Evaluation: cooperation, preparation of materials, measurements and joint publications, membership in commissions for rigorous examinations and in committees for student scientific professional activity.

Name of university/college and faculty: Technical university in Zvolen
Type of cooperation (joint work or other): joint APVV project, publications
Start of cooperation: 2013
Focus: surface treatment, coinage
Evaluation: Department of Production Engineering and Quality Management FEMT TU in Zvolen - cooperation, joint publications

Name of university/college and faculty: University of Western Bohemia, Plzeň, ČR
Type of cooperation (joint work or other): cooperation - testing of coating-substrate systems
Start of cooperation: 2006
Focus: chemical concentration profile analysis, tribological and indentation tests
Evaluation: cooperation, joint publications.

Name of university/college and faculty: AGH University of Science and Technology, Krakow, Poland
Type of cooperation (joint work or other): Bilateral Sk-Pl Project No. 22
Start of cooperation: 2017
Focus: Structural PM steels containing alloying elements with high affinity for oxygen sintered in atmospheres with different chemical composition
Evaluation: cooperation, preparation of materials, measurements and joint publications

Name of university/college and faculty: Politechnika Lodzska, Poľsko
Druh spolupráce (spoločné pracovisko alebo iné): joint project M-ERA RUS Plus, LightMat4Space, Material for space applications based on light nanocrystalline aluminium
Start of cooperation: 2015
Focus: material for space applications
Evaluation: cooperation, joint publications

Name of university/college and faculty: Centrum diagnostiky materiálu, Ústav termomechaniky Akadémie věd České republiky
Type of cooperation (joint work or other): cooperation in testing coating-substrate systems
Start of cooperation: 2006
Focus: tribological testing - scratch tests, nanoindentation
Evaluation: cooperation, joint publications

Name of university/college and faculty: Faculty of Mechanical Engineering TUKE
Type of cooperation (joint work or other): APVV projects, joint publications, PhD studies
Start of cooperation: 2019
Zhodnotenie: APVV projects, joint publications, PhD studies.

Name of university/college and faculty: P.J. Šafárik University in Košice
Type of cooperation (joint work or other): cooperation in joint APVV and VEGA projects
Start of cooperation: 2019
Evaluation: Institute of Chemical Sciences: Preparation and characterization of nanostructured functional layers, biodegradable metallic PM materials. Cooperation, preparation of materials, measurements and joint publications.

Name of university/college and faculty: North Western Polytchnical University, Xian, China
Type of cooperation (joint work or other):: structural and functional ceramics, composites and nanocomposites
Start of cooperation: 2018

Evaluation: cooperation, preparation of materials, measurements and joint publications

Name of university/college and faculty: Faculty of materials, metallurgy and recycling TUKE
Type of cooperation (joint work or other): research, development and innovation in the field of new types of batteries with high density of stored energy and electrode materials, liquid and solid electrolytes, smart monitoring and life prediction of battery systems
Joint laboratory: joint "Laboratory for Battery Research and Innovation - VIB", FMMR, PK11, Park Komenského 11 on the TUKE campus
Start of cooperation: 2021
Evaluation: FMMR and IGT SAS also participate in VIB activities in partnership. The joint laboratory is organizationally integrated into the organizational structure of the partners and is governed by its own statute. The result is collaboration, joint publications.

2.5.8. Supplementary information and/or comments on doctoral studies and educational activities – focused on what changes have occurred since the last evaluation in 2016

In order to broaden our possibilities to teach, train and also to look for new promising young scientists we have signed agreements with faculties and universities beyond our traditional partner – Faculty of Materials, Metallurgy and Recycling of the Technical university in Košice, where we participate in teaching and PhD supervision in related accredited study programmes:
Faculty of Natural Sciences, P.J. Šafárik University in Košice (since 2019),
Faculty of Mechanical Engineering, Technical University in Košice (since 2019),
Faculty of Electrical Engineering and Informatics, Technical University in Košice (since 2020).

2.6. Societal impact

2.6.1. The most important case studies of the research with direct societal impact, max. 4 for institute with up to 50 average FTE researchers per year, 8 for institutes with 50 – 100 average FTE researchers per year and so on. Structure: Summary of the impact; Underpinning research; References to the research; Details of the impact; Sources to corroborate the impact. One page per one case study

1. New biodegradable metallic alloys for biomedical use

Research team led by doc. Ing. K. Saksl, DrSc. has set itself the goal of developing and characterizing new types of alloys with a defined rate of biodegradation inside the human body. The alloys developed are designed for various types of bone damage reparation that require the presence of a support only for a specified period of time after which it will decompose. The application of these materials is focused mainly on the field of orthopedic aids, such as: osteosynthetic screws, plates, rivets, nails used in the process of reconstruction of osteoporotic fractures. Ultralight amorphous alloys (metal glasses) made of bioabsorbable elements (Ca, Mg, Zn, Sr, Si, Zr, Li), i.e. elements that are naturally found in the human body and to which the body has a natural biocompatibility, were developed and analyzed. Metal glasses based on bioabsorbable elements are interesting due to the unique combination of low specific gravity (~ 58% Al and 90% Mg), modulus of elasticity and hardness close to human bone and with strengths above 300 MPa.
The internal atomic structure, thermal stability and functional characteristics were described: mechanical properties, electrical conductivity, corrosion resistance in the environment of solutions close to body fluids, as well as cytotoxicity of osteoblastic cells on the surface of selected types of alloys. Knowledge in the field of detailed study of atomic structures of materials with a high degree of internal disorder, research which is one of the most complicated types of experimental-

theoretical research in the field of materials research and solid state physics, was used in the evaluation of new alloys. Experiments using XFEL X-rays were also performed. laser for studying the dynamics of rigid systems by femtosecond sampling by X-ray method. XPCS photocorrelation spectroscopy.
The results of the work were published in prestigious journals and presented at international conferences: International Journal of Nanotechnology, Journal of Alloys and Compounds, METAL 2019 - 28th International Conference on Metallurgy and Materials and others.
Based on these experiments and works, other national projects were prepared and obtained, in which new types of bioresorbable alloys based on Mg and Zn were developed and studied. The method of intense plastic deformations was used to improve the mechanical properties, and to improve the chemical properties, the following alloys were microalloyed with elements: Mn, Li and Ag. The aim of the research is to prepare a material with the required properties, which after atomization will be used as a precursor (powder semi-finished product) for the production of personalized implants by the methods of additive technologies. In the field of atomization of alloys, international cooperation is developed with the Polish company AMAZEMET. The material and technological outputs of this applied research will be intended for the customer, the company Biomedical Engineering, s.r.o., which prepares intracellular implants tailored to the patient. The obtained implant structures will be applied in case studies with animals (projects: VEGA 2/0021/16, VEGA 2/0013/19, APVV-17-0008, APVV-20-0068, submitted project: VEGA 2/0039/23, APVV -21-0390).

2. Ultra-high temperature ceramics

During the last decades, a growing need has arisen for structural materials that can be used as parts and tools for different combinations of load at temperatures exceeding 2000ºC in oxidizing atmospheres, such as hypersonic vehicles and spacecraft. To date, ultra-high temperature ceramics (UHTCs), based on the refractory carbides, diborides and nitrides of the group IV and V transition metals (e.g. ZrB_2, TaC and HfN), are the only group of materials that can withstand such extreme environments. These materials have potential use as cutting tools, refractory linings, burners, turbocharger rotors and also in energy- and environmental-related applications as porous catalytic materials (i.e. flame stabilizers) in hydrogen burners. Although UHTCs have a number of excellent properties, they are: i) a limited group of materials; ii) macroscopically brittle; and iii) under increasing pressure to perform in more extreme operating conditions due to the demands of developing technologies. A promising solution for the above-mentioned shortcomings of UHTCs is the recent development of bulk high-entropy ceramics (HECs), which consist of no less than four different types of cations stabilized by their configurational entropy, opening up a vast compositional space of new ceramics. Bulk high-entropy carbides and diborides are potential structural materials for extreme environment applications, which can broaden the limited set of ultra-high temperature ceramics (UHTCs). Additionally, HECs are promising materials for broadening the applications and improving the performance of refractory and other advanced ceramics like the well-known advanced ceramics such as cemented carbides and cermets (e.g. WC-Co), silicon nitride ceramics (e.g. β-Si_3N_4) or silicon carbide composites.

High-entropy carbides were first synthesized by a group of researchers at the Queen Mary University of London (QMUL) in the UK, with whom Prof. Dusza and Dr. Csanádi have a long-term collaboration, and their micromechanical properties and structural characteristics were investigated at the Institute of Materials Research - Slovak Academy of Sciences (IMR-SAS) in 2018. Since then, their collaboration has revealed that the hardness and yield strength of high-entropy carbides can go beyond any rules of mixtures for the corresponding carbides and their strengthening is attributed to their enhanced Peierls stresses caused by atomic randomness at the dislocation core. Currently, the synthesis of HECs is rapidly growing but the understanding of their structure-mechanical behaviour relationship is still missing and, therefore, the prediction of their mechanical properties is a great challenge due to their large compositional space. Since HECs are macroscopically brittle at room temperature similar to UHTCs, to improve their inherent mechanical properties, it is important to understand the factors that control their deformability at the level of grains that can only be studied practically using state-of-the-art micro/nanomechanical testing, such as nanoindentation and micropillar compression. This is the field of expertise of Dr. Csanádi who has achieved significant results in the understanding of deformation anisotropy and plasticity of refractory ceramics (WC, β-Si_3N_4) and UHTCs (ZrB_2).

Based on our experience gathered during the collaboration with QMUL, recently, we successfully synthesized a (Hf-Ta-Zr-Nb-Ti)C high-entropy carbide system and tested first time by tribology and nanoindentation[9] at the IMR-SAS in Slovakia. In our department at the Division of Ceramic and Non-metallic Systems, we are employing different strategies for the development of novel carbide- and nitride-based HECs with improved mechanical performance as follows:

1) Strengthening and plasticity through nano and atomic scale design:

Here, the aim is to understand the structure-mechanical behaviour relationship of high-entropy carbides and predict and find high-entropy systems with improved strength or deformability (or both) in the large new compositional space using a nanomechanical testing based approach. The key to improving the deformability and retaining high-strength is to promote both glide on the {111} planes and cross-slip, which can be done by tuning the composition-related properties appropriately, such as lattice distortion and valence electron concentration. This is a multidisciplinary approach realized on a rational set of high-entropy carbide samples, including material synthesis, nanomechanical testing, deformation analysis and modelling.

2) Toughening via microstructural and composition based design:

The aim is to improve the damage tolerance of HECs by tailoring the microstructure and phase composition of multi-phase high-entropy ceramic systems. One of the options is that a strong and heat resistant advanced ceramic toughening phase is added to the high-entropy matrix, such as SiC grains, whiskers or fibres, which can improve the fracture toughness of the sample by different toughening mechanisms (e.g. crack deflection, crack bridging, etc.). Another option is the use of a secondary high-entropy ceramic phase, which is different in structure from the high-entropy carbide matrix. This could be a high-entropy diboride phase, which could toughen the dual-phase HEC composite.

Based on the above approaches, our current research of HECs at IMR-SAS could open up a new direction in the material design of ceramics by tuning the composition-related properties. The research will be extended to high-entropy cemented carbides as composite systems to open up a new line of ceramic research, following the concept of the well-known hardmetals (e.g. WC-Co), for the development of hard and tough refractory ceramic materials with tunable mechanical properties. Certainly, our research will raise new fundamental questions and have a significant impact on the ceramics community.

3. New biocements based on calcium phosphates for tissue replacement

Research team of Dr. Ľubomír Medvecký has been intensively involved in the field of development of materials for human/animal tissue replacement. For the area of maxillofacial use and with regard to the amount of surgical procedures, the preparation was focused on biocement and ceramic systems based on calcium phosphates. A modified fast-setting biocement system based on tetracalcium phosphate / monetite prepared by a patented one-step preparation method and containing soluble nanocrystalline calcium sulfate hydrate (CSH) was developed. Physicochemical and in vitro biological characteristics of the system were analyzed. The results showed a positive effect of cement extracts on the activity of osteoblastic cells by increased release of calcium ions from CSH. Biocement is characterized by a decrease in pH values in the initial stages of cement transformation and a short setting time. Analyzes confirmed the non-cytotoxic nature of the biocement in contact cell culture, and PCR analysis demonstrated significantly increased in vitro osteogenic activity of mesenchymal stem cells in extracts from a cement system containing only 5 wt% CSH. The results of in vitro tests documented the potential of the biocement system for its use in processing bone defects and improving the healing process, which were studied in in vivo models (pigs) by healing defects after application of biocements to the extraction wound, after previous P2 premolar extraction. Radiological histological examination of the newly formed tissue showed that the bone tissue had the same density and structure, comparable to the surrounding, healthy bone tissue with a fully formed compact bone on the surface of the original dental bed under which the spongy bone formed. At the site of the defect, new bone tissue formed, identical to the surrounding alveolar bone. In addition to biocements, ceramic calcium phosphate two-phase high-porous systems have been successfully prepared and tested, achieving a compressive strength of up to 170 MPa, which is completely comparable to the strength of compacts. In vitro and in vivo assays have led to knowledge of the excellent osteoinductive and osteoconductive properties of the developed ceramic systems with good resorption (even without observable

implant residues) and integration with the surrounding bone tissue. Biomaterials are ready for direct testing in human medicine, which is likely to take place in the near future.

4. Nanocomposite materials for ballistic protection

A new lightweight nanocomposite cermic material based on B4C-TiB2-GNPs in the form of hexagonal plates was developed, ballistically tested and successfully integrated into the final ballistic plate, a basic component of an individual ballistic protection vest (project SEMOD-75-2 / 2019 – collaboration with defense industry).
Most ballistic protection elements, such as bulletproof vests or helmets, are currently made from multiple layers of durable fibers (e.g. Kevlar, Spectra, etc.), which can prevent the bullets or shrapnels from penetrating the body. However, targets can suffer blunt force trauma after the strike, such as strong imprints or worse damage to critical organs. Therefore, a research team of scientists from the Institute of Materials Research SAS lead by Dr. Viktor Puchý were looking for an optimal composition of nanocomposites that would dampen projectile impacts more effectively and at the same time would not increase their weight.
A number types of nanoceramic composite materials were designed and their properties were researched. The researchers managed to significantly increase the toughness of ceramics only with the help of graphene nanoplates. In addition, the mechanisms by which graphene stopped the propagation of cracks and forced them to change direction not only in two but also in three dimensions were identified, and utilized. It was shown that addition of very small amounts of superstrong two-dimensional materials, such as graphene, can dramatically change the properties of ceramics.
At present stage laboratory scale production has been mastered. The team can prepare ceramics with better properties than conventional material available on the Slovak market. While maintaining the same thickness, it is possible to increase its durability, so the soldier does not have to carry such a weight.
The developed material was succesfully tested in an accredited laboratory of the company Konštrukta Defence, a. s., which is the main project partner. It is also a producer in defense industry. It was shown that the material can be used not only in element of individual protection but also for armored vehicles or in civil engineering.
The fabrication process, as well as the composition of the new material will be patented and possibilities for effective mass production will be explored.

2.6.2. List of the most important studies and/or other activities commissioned for the decision-making authorities, the government and NGOs, international and foreign institutes (title, name of institution, contract value, purpose (max 20 words))

2.6.3. List of contracts and research projects with industrial and other commercial partners, incl. revenues (study title, name of institution, contract value, country of partner, purpose (max 20 words))

2016
Arrhenius Laboratory, Stockholm University, Stockholm, Sweden,
CEIT Biomedical Engineering, s.r.o., Košice,
Eko-Term Servis, s.r.o., Košice,
Elba, a.s., Kremnica,
Embraco Slovakia, s.r.o., Spišská Nová Ves,
HOBES Slovakia, s.r.o., Trebišov,
INA SKALICA, s.r.o., Skalica,
Kinex Bearings, a.s., Bytča,
KURITA Polska Sp. z o.o., organizačná zložka, Bratislava,
Lear Corporation Seating Slovakia, s.r.o., Prešov,
Lukro trade, s.r.o., Nové Mesto nad Váhom,
Magneti Marelli PWT Slovakia, s.r.o., Kechnec,
Miba Sinter Slovakia s.r.o., Dolný Kubín,

MOPS PRESS, s.r.o., Snina,
REGADA, s.r.o., Prešov,
SKAMRAT a.s., Košice, Spinea, s.r.o., Prešov,
Tatravagónka a.s., Poprad,
Technická univerzita v Košiciach, Fakulta výrobných technológií, Prešov,
Technická univerzita v Košiciach, Hutnícka fakulta, Košice,
Technická univerzita v Košiciach, Strojnícka fakulta, Košice,
Tesla Stropkov, a.s., Stropkov,
Trenčianska univerzita Alexandra Dubčeka v Trenčíne, Trenčín,
ZVS holding, a.s., Dubnica nad Váhom,
Železiarne Podbrezová, a.s.,ŽP VVC, s.r.o., Podbrezová

The contract works comprised of expertises, as well as works carried out in laboratories in determining the basic properties of the material, chemical composition, microstructure, failure, fractographic analyzes, heat treatment of materials. The sum of € 53,894.45 was invoiced for their implementation in 2016 and € 44,678.35 was paid, economic contracts invoiced in 2015 and paid in 2016 amounted to € 14,716.90.

2017

Elba, a.s., Kremnica,
ELZIN, s.r.o. Prešov,
Embraco Slovakia, s.r.o., Spišská Nová Ves,
Hengstler GmbH Aldingen, Nemecko,
HOBES Slovakia, s.r.o., Trebišov,
MASAM, s.r.o., Vráble časť Dyčka,
MOPS PRESS, s.r.o., Snina,
REGADA, s.r.o., Prešov,
SEZ Krompachy, a.s. Krompachy,
Technická univerzita v Košiciach, Fakulta výrobných technológií, Prešov,
Technická univerzita v Košiciach, Hutnícka fakulta, Košice,
Technická univerzita v Košiciach, Fakulta materiálov, metalurgie a recyklácie, Košice,
Hutnícka fakulta, Košice, Technická univerzita v Košiciach,
Strojnícka fakulta, Košice,
ZVS holding, a.s., Dubnica nad Váhom.

The contract works comprised of expertises, as well as works carried out in laboratories in determining the basic properties of the material, chemical composition, microstructure, failure, fractographic analyzes, heat treatment of materials. As of January 24, 2018, € 39,235.60 was invoiced for their implementation as of January 24, 2018, and € 32,385.60 was paid. Economic contracts invoiced in 2016 and paid in 2017 amounted to € 10,266.85.

2018

Expert activities in determining the basic properties of the material, chemical composition, microstructure, failure, fractographic analyzes and heat treatment of materials, etc. In 2021, a total of 26 economic contracts, orders and expert opinions were implemented for the following organizations:
DrakaComteq Slovakia, s.r.o. Prešov,
Elba, a.s., Kremnica,
FTE automotive Slovakia, s.r.o.,
Malý Šariš, GGP Slovakia, s.r.o., Poprad-Matejovce,
HOBES Slovakia, s.r.o., Trebišov,
Kinex Bearings, a.s., Bytča,
KMGroup, s.r.o., Košice,
LM Slovakia, s.r.o., Bratislava,
Materiálové Inovácie, n.o., Košice,
MASAM, s.r.o. Vráble,
MOPS PRESS, s.r.o., Snina,
RAIS Slovakia, s.r.o. Prešov,
Q-System, Košice, Technická univerzita v Košiciach,
Fakulta výrobných technológií, Prešov,

Ústav experimentálnej fyziky SAV, Košice,
Univerzita veterinárskeho lekárstva a farmáciev Košiciach,
KNAHaF, Košice,
U. S. Steel, Vstupný areál U. S. Steel, Košice,
ZVS holding, a.s., Dubnica nad Váhom,
Železiarne Podbrezová, a.s., ŽP VVC, s.r.o. Podbrezová.

As of 16 January 2019, € 33,134.00 was invoiced for their implementation as of 16 January 2018, and € 31,734.00 was paid. Economic contracts invoiced in 2017 and paid in 2018 amounted to € 7,855.00.

2019

Expert activities in determining the basic properties of the material, chemical composition, microstructure, failure, fractographic analyzes and heat treatment of materials, etc. In 2019, a total of 54 economic contracts, orders and expert opinions were implemented for the following organizations:
Andritz Slovakia, s.r.o. Humenné,
Applied Meters, a.s. Prešov,
Elba, a.s., Kremnica,
Embraco Slovakia, s.r.o., Spišská Nová Ves,
GARANT Olomouc, s.r.o., Olomouc,
HOBES Slovakia, s.r.o., Trebišov,
Kinex Bearings, a.s., Bytča,
Lear Corporation Engineering Slovakia, s.r.o., Prešov,
MAATPLUS GmbH, Wuppertal, Nemecko,
MOPS PRESS, s.r.o., Snina,
RAIS Slovakia, s.r.o. Prešov,
REMPO UNIVERS EU, s.r.o., Košice,
RV Magnetics, s.s., Hodkovce,
Schaeffler Kysuce, s.r.o., Kysucké Nové Mesto,
SPP- Distribúcia, a.s. Bratislava,
Syráreň BEL Slovensko, a.s., Michalovce,
Fakulta výrobných technológií, Prešov,
Strojnícka fakulta TU, Košice,
ZKW Slovakia, s.r.o. Krušovce,
ZVS holding, a.s., Dubnica nad Váhom,
ŽP VVC, s.r.o. Podbrezová.

As of 21 January 2020, € 42,025.00 was invoiced for 2019 and € 37,325.00 was paid. Economic contracts invoiced in 2019 and paid in 2019 amounted to € 14,690.00.

2020

Expert activities in determining the basic properties of the material, chemical composition, microstructure, failure, fractographic analyzes and heat treatment of materials, etc. In 2020, a total of 45 economic contracts, orders and expert opinions were implemented for the following organizations:
Biomedical Engineering, s.r.o. Košice,
Ceram Tec Czech Rep., Šumperk,
Elba, a.s., Kremnica,
ELNEC, s.r.o. Prešov,
EMKOS, s.r.o. Kalinovo,
Flow-Ing, s.r.o. Humenné,
Lear Corporation Engineering Slovakia, s.r.o., Prešov,
Marelli PWT, s.r.o. Kechnec,
Neo Slovak, a.s., Košice,
Neo Linz GmbH, Linz, Rakúsko,
Oerlikon Balzers Coating Slovakia, s.r.o. Veľká Ida,
RAIS Slovakia, s.r.o. Prešov,
RECY, s.r.o. Snina,

RV magnetics, a.s. Košice,
Syráreň BEL Slovensko, a.s., Michalovce,
TOMARK, s.r.o. Prešov,
TU – Fakulta materiálov, metalurgie a recyklácie, Košice,
TU - Strojnícka fakulta, Košice,
Ústav anorganickej chémie SAV Bratislava,
Ústav geotechniky SAV Košice,
Vitesco Technologies, s.r.o. Frenštát pod Radhoštěm, ČR,
ZVS holding, a.s., Dubnica nad Váhom,
ŽP VVC, s.r.o. Podbrezová.

As of 22 January 2021, € 27,230.00 was invoiced for 2020 and € 22,580.00 was paid.

2021

Expert activities in determining the basic properties of the material, chemical composition, microstructure, failure, fractographic analyzes and heat treatment of materials, etc. In 2021, a total of 35 economic contracts, orders and expert opinions were implemented for the following organizations:
Andritz Slovakia, s.r.o., Humenné,
ASPEL Slovakia, s.r.o. Kežmarok,
Biomedical Engineering, s.r.o., Košice,
Elba, a.s., Kremnica,
Hengstler, s.r.o. Kežmarok,
KURITA Polska, sp. z. o. o. , Bratislava,
Lear Corporation Engineering Slovakia, s.r.o., Prešov,
Marelli PWT, s.r.o. Kechnec,
MESKO Spólka Akcyjna, Skarżysko-Kamienna, Poľsko,
RV magnetics, a.s. Košice,
SWEP Slovakia, s.r.o., Kechnec,
TU – Fakulta materiálov, metalurgie a recyklácie, Košice,
ZVS holding, a.s., Dubnica nad Váhom.

As of 20 January 2022, € 18,395.00 was invoiced for 2021 and € 14,105.00 was paid.

International research projects:

Contract research project: Huamag
Partner: Huawei Technologies Co, Ltd., China
Period: 2019-2021
Funding: 150 000 €

Partner: Würth Elektronik eiSos GmbH, Germany
Period: 2017-2019
Funding: 130 000 €.

2.6.4.1 List of intangible fixed assets (internally registered IP (confidential know-how), patent applications, patents granted, trademarks registered) denoting background IPR

2.6.4.2 List of licences sold abroad and in Slovakia, incl. revenues (background IPR identification, name of institution, contract value, country of partner, purpose (max 20 words))

2.6.5. Summary of relevant activities, max. 300 words (describe the pipeline of valorization in terms of Number of disclosure, Number of registered IP internally, number of CCR/LIC contracts and their respective summary

values, the support you are receiving in specific points internally at the institute, at SAS, externally – also the limitations and drawbacks.

2.7. Popularisation of Science (outreach activities)

There is a number of regular outreach and popularization activities that IMR SAS either organizes or participates in.

As a part of European Researchers' Night the IMR SAS organizes each year an Open Day when the facilities of the institute are open for students and teachers of primary and secondary schools as well as for general public. The event is connected to a series of lectures about the most important and timely topics in material sciences given at the Institute. The researchers also regularly give lectures at the public places (shopping centre Optima, Košice).

Besides that a great number (around 10 - 20 each year) excursions and one-time presentations of the institute activities and facilities are organized for domestic and foreign visitors, and for university students at the premises of the institute.

The mentioned regular activities were somewhat subdued during 2020 and 2021 due to the pandemic of COVID-19 but we strive to restart their higher frequency again.

One of the specific outreach activities is an educational series of events for children and young students (Fun Primary Science / Fun Natural Science), organised regularly on the premises of the IMR SAS. The institute has built a dedicated laboratory for this series, the series gained a support from the Presidium of SAS in the frame of Open Academy projects, and the organisers were awarded a special prize for popularization by the SAS. Recently, these activities also have had good media coverage.

Recently also a good connection to the local radio and TV stations has been established and a series of short programs is being produced.

2.7.1. List of the most important popularisation activities, max. 20 items

1. ESET Science Award (https://www.esetscienceaward.sk/) is a prestigious award to outstanding personalities of Slovak science.
   - Prof. Ján Dusza awarded in 2021, category Outstanding Scientist in Slovakia.
   - Dr. Tamás Csanádi awarded in 2020 in the category Outstanding Scientist in Slovakia under the age of 35 years.

2. Science and Technology Week - 2016-2018
   Every year, within the frame of the November Science and Technology Week, the IMR SAS organized an Open Day for primary and secondary school pupils and students, as well as for the general public in its premises, where excursions to the IMR SAS laboratories took place.

3. Apart from the aforementioned Open Day, a number of guided excursions to the institute laboratories took place each year, mainly for university students, representatives of universities and research institutes, as well as representatives of the business community.

4. Researchers' Night - 2016-2018
   Every year, IMR SAS joined the event and took part in activities at the science stand for students and the general public in the Optima shopping center in Košice.

5. On the occasion of the 60th and 65th anniversaries of the establishment of the Institute of Materials Research, Five-Yearbooks of the Institute of Materials Research of the Slovak Academy of Sciences were prepared. They bring basic information as well as a overview of activities, development and results of the Institute in periods of 2010-2015 and 2015-2019.

These publications were published in 300 and 200 copies, respectively. They are distributed to existing and potential partners of the Institute and used to promote it.

6. In an effort to improve the promotion and visibility of the institute in the public consciousness, the IMR in 2017 participated in the publication "Košice from Heaven", freely available in bookstores, where it informs about his existence and activities.

7. Researchers and doctoral students prepared an entertaining-educational series on the premises of the institute - Fun Primary Science (Zábavná prvouka) and subsequently Fun Natural Science (Zábavná prírodoveda), intended for primary school pupils. Since 2017, more than 700 students have visited the IMR SAS within this activity. The popularization activity was also financially supported within the "Open Academy" program. This format has met with enthusiastic response so far and has significant potential to continue into the future, while maintaining an appropriate system of institutional support. Fun Science continued in the summer months in cooperation with children's camps. The main purpose of this project is to show 8- to 10-year-olds the work and life of a scientist, to introduce science to them as a normal part of life. In an interesting and playful way, to guide them through the science foundations and to show them easily approachable experiments in chemistry, physics, biology and technology.
   - It was also broadcast as a report within the program Rozhlasové Leporelo (Radio Folder-book) on Regína Radio. https://www.rtvs.sk/radio/archiv/1567/930347.
   - The event was also featured by the local television TV Košice
     https://www.tvkosice.sk/video/5b0590ec4526ca17612625e6
   - Slovak Academy of Sciences' Prize for Popularization
     In 2020, the SAS Prize for Popularization was awarded to the founders of this event, A. Kovalčíková, E. Múdra and I. Shepa.

8. In connection with the joint activities of the Institute of Veterinary Medicine of the Slovak Academy of Sciences and the University of Veterinary Medicine and Pharmacy in Košice, a press conference was held and a series of reports on new biomaterials for the treatment of articular cartilage were presented which met with a broad interest from the media and public.

9. In connection with the promotion of the new Pavilion of Materials Science, in 2016 organized a large number of workshops and excursions for students and professionals from academia and industry under the auspices of the brokerage center.

10. As part of the presentation of material research possibilities using a unique SEM / FIB electron microscope, it was broadcast in RTVS (Radio and Television Slovakia). in 2019 part of Veda a technika (Science and Technology) magazine.

11. As part of the intensification of cooperation with Northwestern Polytechnic University in Xi'an, China, at the invitation of NPU representatives in 2018, the director of the IMR SAS to the NPU made a week-long visit. During the visit, a framework for future cooperation was prepared, which should include not only joint projects but also exchanges of researchers, students and trainees, and the intentions and future research topics were discussed.
    Subsequently, at the invitation of NPU representatives, 2 employees of the ÚMV SAS visited the NPU. During the visit, two invited lectures on the institute's activities were presented. The visit was fully paid for by the Chinese side. At the invitation of the NPU, prof. Dusza month as a visiting professor. During his stay, he completed a lecture tour at 5 academic workplaces, where he presented the IMR of the Slovak Academy of Sciences and the possibilities of cooperation with Chinese universities and academy institutes.

12. IMR SAS builds and develops contacts and cooperation with engineering and raw material industrial enterprises in the Slovak Republic within its membership in the National Technological Platform for Research, Development and Innovation of Raw Materials (NTP VVIS).

13. Cooperation with regional non-academic, public and commercial entities: IMR, together with other Košice institutes of the Slovak Academy of Sciences, as well as other academic and other institutions, is also a participant in the preparation of new activities within the Innovation Center of the Košice Region (ICKK). The first ICKK project will be the Košice New Industry Cluster (CNIC). The region, city and universities will establish it together with the Slovak Academy of Sciences (SAS), L. Pasteur University Hospital (UNLP) Košice and the Košice company Cassovia Discovery Park, with the aim of creating a new modern industry in eastern Slovakia through close cooperation between universities and research institutes. SAS and the private high-tech industry with the support of local governments. At the same time, we participate in the forthcoming Program of Economic and Social Development of the Košice Self-Governing Region (PHRSR KSK).

14. Open Academy: F. Lofaj acted as the coordinator of the scientific topic "Materials for All" (VT1) within the program of "Open Academy" of the Presidium SAS.

15. A. Kovalčíková has been since 2021 member of the Slovak Academy of Sciences' "Commission for Media, Communication and the Open Academy" program.

2.7.2. Table of outreach activities according to institute annual reports

Outreach activities	2016	2017	2018	2019	2020	2021	total
Articles in press media/internet popularising results of science, in particular those achieved by the Organization	2	16	2	4	1	32	57
Appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	3	3	3	1	0	6	16
Public popularisation lectures	21	30	26	22	3	10	112

2.8. Background and management. Infrastructure and human resources, incl. support and incentives for young researchers

2.8.1. Summary table of personnel

2.8.1.1. Professional qualification structure (as of 31 December 2021)

	Degree/rank				Research position		
	DrSc./DSc	CSc./PhD.	professor	docent/ assoc. prof.	I.	II.a.	II.b.
Male	6	23	2	4	7	11	10
Female	0	22	0	0	0	8	14

I. – director of research with a degree of doctor of science/DrSc.

II.a – Senior researcher

II.b – PhD holder/Postdoc

2.8.1.2. Age and gender structure of researchers (as of 31 December 2021)

Age structure of researchers	< 31		31-35		36-40		41-45		46-50		51-55		56-60		61-65		> 65	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Male	2,0	1,5	4,0	4,0	5,0	3,9	4,0	3,5	4,0	4,0	4,0	4,0	3,0	3,0	4,0	3,4	3,0	3,0
Female	1,0	1,0	2,0	2,0	5,0	5,0	6,0	6,0	2,0	2,0	3,0	3,0	1,0	1,0	5,0	5,0	2,0	2,0

A – number

B – FTE

2.8.2. Postdoctoral fellowships (list of positions with holder name, starting date, duration. Add brief information about each fellow's career path before and after receiving PhD degree, etc.)

2.8.2.1. MoRePro and SASPRO fellowships

MoRePro: Dr. Vasily Milyutin (from 15.10.2020 to 14.10.2023)

SASPRO: Dr. Annamária Naughton-Duszová (from 1.10.2021 to 30.9.2024)

2.8.2.2. Stefan Schwarz fellowships

Dr. Ján Balko (from 1.1.2016 to 31.12.2019) - employed at IMR SAS, later left to industry.

Dr. Zuzana Birčáková (from 1.6.2018 to 31.5.2020) - employed at IMR SAS

Dr. Tamás Csanádi (from 1.6.2018 to 31.5.2021) - employed at IMR SAS

Dr. Richard Sedlák (from 1.6.2019 to 31.5.2021) - employed at IMR SAS

Dr. Tibor Sopčák (from 1.5.2017 to 30.4.2019) - employed at IMR SAS

2.8.2.3. Postdoctoral positions from other resources (specify):

Dr. Susanta Kumar Tripathy (from 1.11.2019 to 30.11.2019 - SAIA)

Prof. Mikhailo Brykov (from 3.9.2018 to 30.6.2019 - SAIA)

Prof. Vasyl Iefremenko (from 1.9.2019 to 30.6.2020 - SAIA)

Dr. Aliasghar Najafzadehkhoee (from 13.9.2019 to 30.6.2020 - SAIA)

Assoc.prof.Dr. Vitaliy Bilanych (from 2.2.2020 to 30.9.2020 -SAIA)

2.8.3. Important research infrastructure introduced during the evaluation period with the information about the sources of funding *(max. 2 pages)*

Laboratory of 3D technologies / Additive manufacturing laboratory

The laboratory is focused on the rapid prototyping, preparation of components and complex shaped parts needed for a variety of scientific research activities. With this method, it is possible to make plastic prototypes and models of new components needed for further research. The laboratory is equipped with three devices for 3D polymer filament printing. At the same time, it is used for the preparation of aids for popularization activities at the IMR SAS. The infrastructure was funded using domestic VEGA and APVV projects.

Ceramic Powder Treatment Laboratory

The laboratory is focused on the complex preparation of ceramic and nanocomposite powder mixtures intended for the development of advanced structural ceramics using SPS technology - Spark Plasma Sintering. The laboratory is equipped with a shaft stirrer designed to homogenize

powder suspensions, a glove box for working with powders in an inert atmosphere to prevent oxidative contamination of powders. The infrastructure was funded using domestic VEGA and APVV projects.

High Energy Milling technique

In 2021, the Retsch Emax mill for high-energy grinding was purchased. The unique combination of high friction and impact allows the preparation of ultrafine particles in a very short time, as well as the coating and preparation of core / shell particles. The purchase was financed from the resources obtained from the Huamag project (EUR 41,000).

Magnetic properties measurement

As part of the MoRePro project, an apparatus for measuring the magnetostriction of materials was built. The "strain gauge method" of measuring magnetostriction in an external magnetic field generated by an electromagnet makes it possible to obtain additional physical characteristics of magnetic materials. The source of funding was the MoRePro project (EUR 7,000).

Electro-chemical laboratory

The new electro-chemical laboratory was established to investigate the electro-catalytic properties of prepared heterogeneous catalysts. The laboratory is equipped with a new-generation potentiostat/galvanostat Vionic that is powered by Autolab's new **intelo s**oftware. **VIONIC** offers the **most versatile combined specifications of any single instrument** currently on the market. As part of electrochemical characterization, it is possible to perform classical electrochemical procedures such as cyclic voltammetry, linear sweep voltammetry, chronoamperometry or but also more complex procedure than electrochemical impedance spectroscopy. Within the new laboratory the catalysts will be tested in the laboratory designed PEM electrolyzer with titanium bipolar plates and nafion as a solid membrane. The laboratory was established using predominantly the funds from an industrial research contract (Würth Electronic).

Laboratory for Battery Research and Innovation - VIB

New joint laboratory together with FMMR TUKE and IGT SAS. The laboratory is organizationally integrated into the organizational structure of the partners and is governed by its own statute. Its aim is research, development and innovation in the field of new types of batteries with high density of stored energy and electrode materials, liquid and solid electrolytes, smart monitoring and life prediction of battery systems. The result is collaboration, joint publications, teaching. The main contribution from the IMR SAS is a glove box, purchase of which was funded from VEGA and M-ERA.Net projects.

2.9. Supplementary information and/or comments on all items 2.1 – 2.8 (max. 2 pages in total for the whole section)

Institute of Materials Research has a well developed cooperation with industry in the form of implementation of research tasks on the basis of economic contracts aimed for the field of industrial and/or societal sphere. The most important cooperation with the practice can be summarized:

In the field of defense engineering for MSM GROUP a.s. In the years 2016 to 2021, expert evaluations of the state of the microstructure were systematically carried out in correlation with the fragmentation and strength properties of moldings for the 155-caliber series of large-caliber ammunition products intended for self-propelled cannon howitzers.

For the energy industry (ELBA, a.s. Kremnica), expertise on fittings for external power lines was repeated in the years 2016 to 2021. The output of the work was the recommendation of

corrective measures within the system of production quality assessment in accordance with ISO 9001 and environmental management according to ISO 14 001.

The specific requirements of castings for the automotive industry (MopsPress a.s. Snina) were aimed at evaluating the porosity and microstructure of high-pressure die-cast aluminum alloy castings on machines with a cold horizontal chamber.

In the field of development of electrical steels, in cooperation with Embraco Slovakia s.r.o. implemented research application project APVV-15-0259 with a focus on improving the final magnetic properties of electrical steels through the influence of tensile and compressive elasto-plastic deformations on the evolution of microstructural and textural parliaments of electrical steels of the semi-rigid type. Technological procedures for the processing of electrical steels by means of "positive" bending deformations during belt straightening for rotor and stator segments were designed and tested under operating conditions. Subsequent heat treatment of the cut segments under dynamic conditions showed an improvement in their wattage losses of 17% compared to conventional treatment.

3. *Implementation of the recommendations from the previous evaluation period*

The previous assessment of the activities of the Institute in 2016 has given us several quite general advices and comments on how the improvement could be made. They can be summarized as follows:

- Emphasis on human capital formation should be recognised and encouraged,
- Await competition under H2020 and subsequent programmes,
- Assure returns from increased linkages with national and regional enterprises and public bodies,
- The domains of research have considerable potential for increased market linkage both nationally and internationally - so the advice was to implement a strategic plan - within national research planning,
- To intensify collaborative research with non-academic institutions.

Based on these general outlines, the Presidium of SAS made several more concrete recommendations:

- Increase efforts in the domain of joint publications with foreign partners. Intensify mobility with a positive impact on career growth and innovation capacity.
- Improve the use and building of human capital.
- Improve competitiveness in international grant schemes (H2020, Marie Curie Actions,…).
- Following the "Open Academy" program, create mechanisms to improve the cooperation of SAS organizations within the relevant SAS department and between individual SAS departments, e.g. on the basis of projects, regular annual seminars or the functioning of directors' functional boards,
- Establish an International Advisory Council.

Following these recommendations the Institute has adopted the Action Plan. Its implementation can be characterized in several domains:

Improving the quality of research outputs

The outputs of researchers and doctoral students are evaluated periodically and the remuneration is strictly reflected in the results of this evaluation.

Improving the quality of doctoral studies

In connection with the need to activate doctoral studies and the change in the Higher Education Act, IMR SAS established during the last five years relations with other three faculties in Košice for which it now can serve as an External educational institution. Three new study programs have been accredited. At present also talk with other universities outside Košice are underway, and also there are some preparations for formalizing collaboration with foreign educational institutions.

In this respect also cooperation with industrial enterprises was activated. Several external doctoral students from industry were accepted, one in 2019 successfully defended his PhD. At present the Institute supervises 4 external PhD students.

Career growth of postdoctoral fellows and researchers

A system of motivation for obtaining higher qualifications has been implemented, especially for higher levels such as DrSc. and external (associated) professors. We offer sabbaticals, longer paid periods during working stays abroad, monetary incentives depending on the scientific output and success, and social recognition. Furthermore, we presented and implemented

incentives for increasing scientific qualification of younger scientists, we encourage applications for new senior researchers, new suppervisors of PhD students. Again, longer paid periods during stays abroad.

We make an effort so that a prospective young researchers receives a short-term contract and usually seek funding from external sources (projects, grants, Schwartz scholarship) during the year. Regular evaluation and remuneration also applies to these employees, which motivates them to increase their performance. As for further career growth.

In the evaluated period, one DrSc. dissertation and two habilitation theses were presented and defended.

Gaining and applying experience from leading foreign experts, internationalization and following good practice from abroad, researchers mobility

In accordance with the recommendations and tasks set out in the Action Plan, the International Advisory Board of the Institute was composed in 2019 from the world's leading experts. Unfortunately, the travel restrictions connected to COVID-19, so far has prevented us from a personal meeting, until now only online discussions have been made.

Regarding the mobility of researchers, the Institute has been active in internationalization both doctoral studies and exchanges of young researchers, post-docs, as well as experienced scietists. Cooperation with a number of foreign universities and academic institutions has intensified. The Institute hosted an increasing number of young researchers and doctoral students from abroad (many of them outside the EU) with medium-to-long term stay period of one month to one year (2017: 5 persons, 2018: 5 persons, 2019: 10 persons, 2020: 5 persons, 2021: 2 persons). This trend was interrupted in 2020 - 2021 by the outbreak of COVID-19 but we hope that it will resume in the following period.

Local and regional collaborations

We also try to build a local science - technology - innovation - manufacturing ecology. Currently we participate in initiatives such as Košice Science City (a joint effort of local unversities and govermental institutions to build a foundation for local knowledge driven economy), or Košice New Industry Cluster (CNIC). The Institute will systematically continue to take measures to improve and support the career development of researchers and to better cooperate with industry.

Competion for international funding

The institute supports the submission of grants in the form of one-off rewards. In the last period, 4 ERC projects have been developed and submitted, but so far they have not been successful.

Restructuraliztion of the Institute in 2016 gave us better structure for supporting larger and more robust research teams. We believe that we are succeeding in improving the quality of scientific outputs, intellectual property, and expanding the internationalization of research and doctoral studies. Following that the Institute was very active in an effort to obtain funds from international grant schemes. We participated in consortias for 3 large scale projects aimed at buidling/sustaining the national joint research centers together with large industrial partners, and also in 6 projects of the so-called long-term starategic research initiative of the Slovak Government. These schemes were supposed to be funded mostly from the European Structural Funds. However, for the external reasons, these applications were mostly unsuccessful (the mentioned calls were cancelled). So, there is no systematic improvement in the success of obtaining funds from the international grant schemes. As a consequence, the Institute has to be very active in applications for national projects. In this domain we are quite succesful, as seen from the large number of the projects given in the section 2.4. However, these projects are relatively small and for their limited finances carry high administrative burden. Certainly, fewer but better funded projects would be desirable.

4. ***Research strategy and future development of the institute for the next five years*** (Recommended 3 pages, max. 5 pages)

Research strategy of the institute in the national and international contexts, objectives, and methods (including the information on when the strategy was adopted)

a) Advanced metallic materials

Hydrogen embrittlement of construction materials and possibilities of its prevention: From the point of view of the use of construction metallic materials exposed to hydrogen, it is necessary to consider the possibility of the occurrence of the phenomenon of hydrogen embrittlement. The microstructural conditionality of hydrogen embrittlement will be investigated in relation to mechanical stress conditions. The possibilities of hydrogen embrittlement prevention will be based on the use of modern methods of surface modification to apply a barrier effect against hydrogen permeability. (project VEGA 2/0072/22)

Gradient materials for engineering applications: Strategically, research is focused on tool surface treatment (e.g. microtexturing) for primary wood processing for energy purposes and in die casting technologies for restoration of functional parts of molds for high-pressure casting of aluminum alloys by laser welding of newly designed filler materials. Research will also focus on increasing the operational durability of press tools through the development of a comprehensive technology for the formation of nano-structural layers using modern surface engineering techniques. (projects: APVV-20-0303, APVV-21-0180, APVV SK-UA-21-0023)

Li-ion batteries: The aim of the project "Development of novel 3D materials for post lithium ion batteries with high energy density" is the preparation and characterization of new composite materials with self-healing functions, which will be finally integrated into a small prototype. These new materials will be safer and more stable thanks to the composite 3-D structure, which will improve their performance and extend their life. (project: APVV-20-0138)

Metal hydride alloys for efficient hydrogen storage: The aim of the projects is the development and research of metal hydride materials of the latest generation - the so-called high-entropic alloys, which have the highest volume of hydrogen storage among the materials used. (projects: APVV-20-0205, VEGA 2/0039/22)

Biodegradable alloys: The aim of the projects is the development and research of bioresorbable and biodegradable alloys for intra-body implants and other biomedical applications. The project focuses on the possibilities of increasing plastic deformability while maintaining strength and slow dissolution rate. The obtained results will be put into clinical practice by the contracted company. (project: APVV-20-0068, submitted projects: APVV-21-0390, VEGA 2/0039/23)

Electrical steels for electric vehicles and hybrid engines: Future research will focus on the development of an innovative technological process for the processing of non-oriented electrical steels, the proposed process will be based on the use of selective deformation-induced growth of ferrite grains under the gradient of internal compressive and tensile stresses. Experimental research will also focus on optimizing the microstructure and texture of various grades of electrical sheets in order to minimize electromagnetic losses and optimize the conditions for the production of rotor and stator bundles by cutting and subsequent joining. (projects VEGA 2/0106/21, APVV-21-0418)

Phase diagram modeling and development of thermodynamic databases: In the field of thermodynamics, we will focus on expanding the possibility of designing new materials for high-temperature applications by computational methods without the need for time-consuming experimental testing. The Calphad method will develop the parameter databases needed for thermodynamic calculations for iridium-containing systems. (project VEGA 2/0038/21)

Metal-ceramic composites and nano-composites: The research will focus on the development of new gradient micro / nano composites with Al matrix with added ceramic particles and carbon nanoparticles with the possibility of applications in the automotive, aerospace and defense industries. Another possible approach to the production of new composites is the use of some waste materials, e.g. from machining operations. Separate research is focused on the systematic investigation of the influence of mechanical activation on the sintering and synthesis of BZT

ceramics and its dielectric properties. (projects: VEGA 2/0114/23, VEGA 2/0113/23, Mobility (SAV-SAVU-21-01))

Intermetallic alloys: The aim of the project is to bring new knowledge in the field of structure and thermal stability of Ni2FeGa alloy with non-stoichiometric composition prepared by rapid solidification and the influence of its chemical composition on selected properties such as shape memory phenomenon, magnetic properties and magnetocaloric phenomenon. It is expected that by a suitable combination of the magnetocaloric effect, the induced deformation using the shape memory phenomenon, it would be possible to prepare an alloy for barocaloric cooling with high efficiency. (project VEGA 2/0086/22)

b) Ceramic and non-metallic materials

Advanced ceramics and ceramic based composites: During the next years the research and development in this group of division will focus on the high – entropy ceramics mainly for ultra – high temperature applications based on carbides, nitrides, carbo – nitrides, borides and dual – phase systems. The aim of these activities will be to develop extremely hard and damage tolerant high entropy ceramics for application in extreme environments with excellent physical, mechanical, tribological and high temperature properties by designing their structure at nano/micro/macro level. For fracture toughness/damage tolerance improvement in-situ toughening, toughening by SiC whiskers and graphene platelets and texture/layered design will be applied with the aim to reach high fracture toughness. Designing of novel high – entropy UHTCs and high – entropy UHTCs based composites with high damage tolerance at atomic and nano level, at micro level for preparation of in - situ – reinforced systems, whiskers/fibre/platelets reinforced systems and at macro level for preparation textured/layered systems through structural design. The high – temperature properties will be improve through grain segregation for higher hardness and grain boundary design for higher strength for higher oxidation and ablation resistance through grain boundary engineering. In international collaboration with partners from United Kingdom, Germany, Poland, Hungary, etc we will work on the development of other ceramic based composites, too.

Improving the performance of hard PVD coatings for demanding engineering applications: Long-term research in the field of hard ceramic PVD coatings development will focus on multi-component nitride, carbide and boride systems in the field of materials and on the development of PVD sputtering methods with better control of the degree of ionization in the technological field. The aim is a combination of both approaches leading to increased toughness while maintaining (or increasing) hardness, thermal and chemical resistance and subsequently improving the tribological performance and durability of hard PVD coatings in engineering applications.

Nanofibrous materials for special technical applications: Strategically, the research is focused on the development of ceramic oxide fibers based on copper, zirconium, HEO (high entropy oxide) and HEC (high entropy carbide) in the field of new materials suitable for battery applications and photocatalysis. Also as special fillers for composite materials. Research will also focus on the use of recycled raw materials.

c) Hybrid materials, biomaterials, functional materials

Hydrogen technologies: The IMR SAS with the National Hydrogen Association of Slovakia (NVAS) is an association supporting the deployment of hydrogen technologies as a sustainable way for carbon neutrality. The hydrogen economy will not be sufficiently developed without the help of state subsidies. With an increasingly intermittent renewable generation, water electrolysis will be potentially advantageous for electricity grids stabilization, where rapidly responding loads can meet the needs for a variety of grid services. The main target will be contributed to the economic competitiveness of the water electrolysis technology. Considerable effort will be devoted to the development of the cost effective non-noble metals electrocatalysts for (polymer exchange membrane electrolyzer) PEM and alkaline water electrolysis. The main innovativeness consists in development of the new, highly innovative type of electrocatalysts based on transition metal pohosphides (TMPs) and TMPs supported by carbonaceous materials. Materials selected will be characterized by high catalytic activity and at the same time, they avoid utilization of the critical raw materials. In order to utilize fully their potential, novel gas-diffusion electrode based on TMPs will be developed. This concerns especially TMPs carbon fibers, i.e. materials significantly differing from those used in the water electrolysis cells up to the date. The results obtain will thus significantly contribute both to the knowledge in the field of materials science and engineering, as

well as energy conversion and storage with a special focus on water electrolysis as a green hydrogen source.

Electrocatalytic materials for green energy: The preparation and characterization of new types of ionic conductors and electronic insulators – utilized as solid electrolytes will be another field of research. Oxide- or sulfide-based as well as oxisulfide-based crystalline and amorphous solids which conduct electricity via migration of alkali ions will be developed, with an emphasis on lithium-ion conductors. Mechanical, electrical and electrochemical properties of solid electrolytes themselves and of composites from solid electrolytes and materials currently used in electrodes of Li(Na, K, ...)-ion cells will be studied.

Soft magnetic PM materials: The research strategy of magnetically soft PM materials will focus on the application of machine learning and artificial intelligence methods. Within the framework of current projects, intensive work is being done on the development of a database of correlations of structure and properties of magnetically soft materials investigated so far. Selected machine learning and prediction algorithms will be applied to the created database. The aim is to explore the possibilities of reducing extensive experimental procedures in the field of research and development of magnetically soft composites. The long-term goal is to create a database of supercritical size and optimal data structure, which will allow the prediction of technological parameters of the production of magnetically soft materials based on the given requirements for magnetic, electrical and mechanical properties. The basic partial goal is the formal and contents based unification of scientific methods and outputs generated in the field of magnetically soft composite materials at the international level, at least in the framework of active formal or informal cooperation with partners in the field.

Biomaterials for regenerative medicine: In the field of biomaterial research focused on regenerative medicine, the strategy in the future will focus on the development of new processes for the preparation of composite calcium phosphate systems and biocement compositions as well as study materials supporting the regeneration of soft tissues (e.g. skin). It will be necessary to involve physicians from hospitals or medical faculties in close cooperation in order to successfully start and develop the process of direct implementation of developed biomaterials into medical practice, from which the institute could benefit not only by involving the private business sector but also secondarily by supporting targeted research in the field. areas. It is clear that the introduction of material into medical practice requires considerable material, technical and human resources, including a relatively long period of clinical trials, but for a meaningful direction of research, we assume that this step will be necessary.

Principles and methods to achieve the desired objectives

The main principles and methods to resolve research and development tasks as well as the above defined main areas will be during the next period preserved and also developed in quality, connected to further development of infrastructure and means of the international funding and for the development of personnel and staffing.

Further staff development will be endorsed, effective measures include:

1. If possible, increased level of financial remuneration of the top scientists and differentiation in the remuneration of the personnel. For this stable financing fully ensuring the payroll from institutional sources is required;
2. If possible, it is desirable to increase the number of employees so that each specialized piece of equipment or facility has at least two persons assigned to it;
3. Reinforcing the competitive environment within the workplace together with the creation of conditions for continual education of the workers and engaging doctoral students (employees) from third countries.

Another important condition is increasing the space for scientific work in comparison with the non-productive administrative burden by way of orientation toward multinational projects and higher funded national projects.

We shall work on strengthening the position of IMR SAS to a European-wide standard by being engaged in European international projects in the European Research Area, as well as in the topics of space, defence, new industries, and biomedicine.