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

Period: January 1, 2012 - December 31, 2015

1. Basic information on the institute:

1.1. Legal name and address

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

1.2. URL of the institute web site

http://www.imr.saske.sk/

1.3. Executive body of the institute and its composition

Directoriat	Name	Age	Years in the position
Director	Dr. Peter Ševc	50	2.5
Deputy director	RNDr. Ján Mihalik	56	2.5
Scientific secretary	Dr. Karel Saksl	42	2.5

Directoriat	Name	Age	Years in the position
Director	Dr. Pavol Hvizdoš	51	1.5
Deputy director	RNDr. Ján Mihalik	56	1.5
Scientific secretary	Dr. Karel Saksl	42	1.5

1.4. Head of the Scientific Board

Prof. Dr. Ján Dusza – to 05/2013

Dr. Pavol Hvizdoš – from 06/2013 to 06/2014

Dr. Ľubomír Medvecký – from 07/2014

1.5. Basic information on the research personnel

1.5.1. Number of employees with university degrees (PhD students included) engaged in research projects, their full time equivalent work capacity (FTE) in 2012, 2013, 2014, 2015, and average number of employees in the assessment period

	2012		2013		2014		2015		total		
	number	FTE	number	FTE	number	FTE	number	FTE	number	averaged number per year	averaged FTE
Number of employees with university degrees	57,0	50,090	61,0	49,790	63,0	51,510	57,0	48,710	238,0	59,5	50,025
Number of PhD students	13,0	10,320	13,0	11,000	15,0	12,320	14,0	12,240	55,0	13,8	11,470
Total number	70,0	60,410	74,0	60,790	78,0	63,830	71,0	60,950	293,0	73,3	61,495

1.5.2. Institute units/departments and their FTE employees with university degrees engaged in research and development

Research staff	2012		2013		2014		2015		average	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
organisation in whole	57,0	50 ,09	61,0	49,790	63,0	51,510	57,0	48,710	59,5	50,003
VO 1 - Microstructure and Mechanical Properties of Steels	3,0	3,000	3,0	3,000	3,0	3,000	3,0	3,000	3,0	3,000
VO 2 - Microstructural Engineering of Steels	7,0	6,000	6,0	5,000	7,0	6,000	6,0	4,150	6,5	5,288
VO 3 - Diffusion and Transformation Processes in Metallic Systems	6,0	5,830	6,0	4,830	7,0	6,000	6,0	5,500	6,3	5,540
VO 4 - Ferrous Powder Metallurgy	10,0	8,730	10,0	8,100	10,0	8,000	8,0	7,500	9,5	8,083
VO 5 - Nano Structured Materials	8,0	8,200	7,0	6,600	7,0	6,500	8,0	6,730	7,5	7,008
VO 6 - Electroceramics	5,0	5,000	5,0	4,250	5,0	5,500	5,0	5,000	5,0	4,938
VO 7 - Structural Ceramics	14,0	9,730	20,0	14,410	20,0	13,010	18,0	13,830	18,0	12,745
OTaK - Technology and Design	1,0	1,000	1,0	1,000	1,0	1,000	1,0	1,000	1,0	1,000
OMSK - Mechanical Testing	1,0	0,600	1,0	0,600	1,0	0,500	0,0	0,000	0,8	0,425
IVTAM - Informatics, Computers and Applied Mathematics	2,0	2,000	2,0	2,000	2,0	2,000	2,0	2,000	2,0	2,000

1.6. Basic information on the funding of the institute

Institutional salary budget and others salary budget

Salary budget	2012	2013	2014	2015	average
Institutional Salary budget *[thousands of EUR]*	595,575	520,996	599,368	619,639	583,895
Other Salary budget *[thousands of EUR]*	190,672	345,162	223,064	183,306	235,551

1.7. Mission Statement of the Institute as presented in the Foundation Charter

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 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 assessment period in both national and international contexts, (recommended 5 pages, max. 10 pages)

During the assessed period the Institute of Materials Research of SAS was active in the following main research areas:
1) advanced metallic materials (steels, non-ferrous materials, advanced alloys);
2) advanced structural ceramics and non-metallic materials;
3) hybrid materials, biomaterials, functional materials.
The research activities were carried out within national (VEGA, APVV, etc.) projects and international (7th FP EU, ERA-NET, COST, EU Structural Funds etc.) projects.

1) Activities of IMR SAS in the field of **advanced metallic materials** are summarized in the following overview:

1a) Microstructure and mechanical properties of steels

"Strain and Fracture Properties of Dual Phase Steels for Automotive Industry", projects: VEGA 2/0192/12 (2012-2014) and VEGA 2/0176/15 (2015-2017)

In regards to the development of new high strength steels, study was made on the influence of intercritical hardening on the deformation and fracture behaviour of various types of commercially produced steels in static, impact and cyclical stress. Experiments included tests intended for investigating the effect of microstructural heterogeneity across the thickness of a steel sheet for the ability of dual phase steels (DP steels) to absorb energy. Initial signs of the development of local plastic deformation at individual stages of the deformation and fracture process were studied by means of a scanning electron microscope as well as miniature samples cut free from various undersurface and mid areas of the steel sheet, including measuring the extent of plastic zone in the vicinity of drilled openings, notches and faces of fatigue cracks. It was found that the steels with structure exhibiting high tendency toward localization of plastic deformation may have in the presence of a notch an extremely low ductility and fatigue resistance,

despite excellent combination of strength and tensibility, which is a typical property of DP steels. An experimental program was realized with 8 steels, which included controlled hot rolling and cold rolling with the subsequent intercritical hardening in wide temperature intervals. It was found that for steels with the chemical composition 0.15-C-1.2Mn-0.02Si-0.2Mo-0.1 these could reach strength up to Rm = 1000 MPa and at the same time can be bent 180 °C (bending radius 0.5 mm). High strength and excellent bending properties are the result of introducing nano-precipitates (< 5nm) to ultrafine ferrite + martensite microstructure (< 2 μm).

"Application of progressive tool coatings for increasing the effectiveness and productivity of forming sheets made of modern materials", project APVV-0682-11 (2012-2015)

The applied research was focused on increasing the technical lifespan of instruments designed for pressing and joining aluminium black and hot galvanized steel sheets for application especially in the automobile industry. For instruments (produced from materials 1.3343, 1.2379, 1.2990 and K390 with deposited PVD coatings of the type ZrN, TiCN-MP and CrN) critical areas were identified from the standpoint of loss of the required functional properties. Research of the technical lifespan of instruments intended for pressing and pressure linking realized in laboratory and operational conditions was combined with material analysis, FEM analyses in elastic and elasto-plastic area for determining stress distribution in the instruments and analyzing the changes in micro-geometry of the surfaces of the functioning parts of the tools. With individual tool degradation mechanisms were identified and knowledge was acquired as to their time variance and mutual effect over the course of the lifespan of concrete tools. Also there was a demonstration in laboratory and operational conditions by replica application on the basis of fast hardening dual-component flexible silicone elastic. The replicas well document the morphology of the surface, enabling information about the hard to reach surfaces of the tool or structure to be gained.

1b) Microstructural engineering of steels

"The microstructural design of electrotechnical steels"

During the period 2012 – 2015 within the framework OMIO 3 projects were addressed within ASFEÚ, 2 projects within agency VEGA and 1 project supported by the agency APVV. The projects were focused on the material aspect of electro-technical steels and concerned isotrope type steels, finished and semi-finished, grain-oriented streels and partial and high-strength electrotechnical steels. From a scientific perspective the focus was on the structure-forming and texture-forming processes in the thermal and thermic-deformation exposure during the processing of these materials. Dominant attention was given to the process of deformational inductive movement of grain boundaries during abnormal and selective growth of ferrite grains. Original findings were gained as part of working the project, enabling one with the aid of the deformational inductive movement of grain boundaries to reach an increased cubic texture component in isotropic electro-technical steels, and in grain oriented steels in combination with the inhibitory effect of nanoparticles on the VC basis to achieve Goss crystallographic texture in the dynamic conditions of heating.

"Preparation technology of electrotechnical steels with high permeability intended for electrical motors with higher efficiency", project ITMS 26220220037, (2010-12)

Knowledge acquired allowed the preparation of columnar microstructure in isotropic electro-technical steels with a marked representation of cubic texture components, they were the basis of the technical resolution, upon which was awarded patent no.: 288322, by the Patent office of the SR.

"Novel materials and technologies for energy", project ITMS 26220220061 (2010-13).

The activity was focused on the area of the selective growth of Goss grains in grain-oriented steels. Based upon project results a new inhibitory system was proposed for the movement of grain boundaries on the VC basis, enabling a cultivation of Goss grains in dynamic conditions with significant energy savings. The acquired findings were the basis for the technical resolution in patent application no. PV 00091-2012.

"The research center of efficiency of combined systems integration for renewable energy sources", project ITMS 26220220064 (2010-13).

The work activity at ÚMV SAV was focused on the evolution of microstructure in electrotechnical steels of the semifinished type. Resulting from the project was the proposed procedure of deformation hot processing of electromotor segments, which proved to improve its efficiency overall under stress loads by approx.1.5 %.

"High-strength electro-technical composite steels", project APVV 0147-11 (2012-15).

The project was focused on microstructural design in high-strength electro-technical steels intended for hybrid drives and electro-mobiles. Within the submitted project is the proposed original conception of high-strength electro-technical steels based on composite gradient configuration of the microstructure, substructure and texture across the sheet thickness. Patent application rendered PV: PP 00090-2015.

1c) Diffusion and transformation processes in metallic systems

"Modification of microstructure and properties of creep-resistant steels welds", projects: VEGA 2/0128/10 (2010-2012) and VEGA 2/0116/13 (2013-2015)

Research in the area of progressive creep-resistant steels and their welds for high-efficiency ultra-supercritical boiler systems was concentrated on the study of the influence of conditions of the initial technological processing and specific alloying for modification of their microstructure and resulting properties. Experimental testing conditions, taking into account selected aspects of loading of welded joints included measuring hardness, impact toughness, creep tests and tensile tests of thermally exposed states. From a material standpoint research was done on homogeneous and heterogeneous weldments of steels T/P91, T/P92, T24, CB2 and TP316H completed with hot melting technologies of welding employing various additional materials. Individual types of welds from the viewpoint of combining basic materials and welding metals were studied for the purpose of characterizing the development of their structural and phase composition in the conditions of thermal and thermal-deformation exposure. Complex research of welds of the presented creep-resistant steels revealed the possibility of lengthening the lifespan of energy boiler units.

"Thermodynamic description and modelling of phase diagrams of boron doped systems", projects: VEGA 2/0153/12 (2012-2014), VEGA 2/0153/15 (2015-2017), SAS-ASCR-15-11 (2015-2017)

Developed within the projects were thermodynamic databases required for various types of thermodynamic calculations and the databases created were used for modelling phase diagrams of systems with boron by the method Calphad. This concretely dealt with systems Fe-B-Cr, Fe-B-Mn and all of their subsystems. This was based on the theoretical models for binary subsystems and from the experiments carried out measuring the model ternary alloys annealed long term at high temperatures. Used for experimental methods were X-ray diffraction, EDX analysis and DTA-measuring, which provide information useable from the viewpoint of thermodynamics and phase diagrams. Creation of a database enables all types of thermodynamic calculation to be performed for a given system and all subsystems, i.e. enabling the determination of phase equilibrium, amount and chemical composition of equilibrium phases, calculations of quantities of G, H, S, Cp and their dependence, plotting phase diagrams and their varied sections, projection of liquidus etc, and then the overall chemical composition of individual ternary systems.

1d) Nano-structured materials

"Effect of intensive plastic deformations on microstructure and properties of advanced composite nanomaterial systems", projects: VEGA 2/0025/11 (2011-2013), VEGA 2/0118/14 (2014-2016), SAS-NSC-2010-06 (2010-2013)

In addressing the projects a simulation of the process ECAP in the program DEFORM was realized by the method of finite elements. The aim was to analyze and optimize geometric and thermal parameters and stress values of the ECAP process. The influence of thermal processing of system Al-C on the microstructure, high temperature properties and fracture characteristics were evaluated. Creep properties and fracture behaviour of systems Mg-Al_2O_3 and Al-Al_4C_3 were analyzed by the "small punch" method. The system Cu-Al_2O_3 with its micro and nano matrix was evaluated for the characteristics of wear, nanoindentation hardness and module flexibility. Analyzed by the method "in situ tensile test in SEM" was the deformation Mg alloy and Cu-Al_2O_3 and models of displacement were proposed. Upon system Al-Al_4C_3 was defined the tolerance factor of creep displacement for extruded and ECAP-ed material. The influence of temperature and the speed of deformation was specified on the superplastic behaviour disperse strengthening of the system Al-Al_4C_3. Materials Glidcop (Cu–Al_2O_3) and AZ61-Al_2O_3 were evaluated for the microstructure, coefficient of friction and wear rate under elevated temperatures. At the same time fracture micromechanisms were evaluated and displacement models were proposed.

"Novel explosive welded corrosion resistant clad materials for geothermal plants", project M-ERA.NET (2014-2017)

The aim of the project is the development and characterization of completely new types of bimetallic materials prepared by the unconventional method of explosion welding, design for applications in geothermal power stations. The research team from ÚMV SAV is responsible in this project for characterizing the prepared bimetallic systems from the perspective of phase composition and the share of internal tension in the materials. Along with this research were realized several experiments on sources of synchrotron radiation at DESY Hamburg, NSR and ESRF in Grenoble, France. Project coordinator: Warsaw University of Technology, Poland. Partners: IMR SAS, EXPLOMET Poland, ICI Iceland

"Study of microstructure and thermal stability of metallic glasses and nanocrystalline materials", project VEGA 2/0128/13 (2013-2015)

Within the project was realized development research of new metallic glasses on the basis of Zr and Cu. Described in detail was the atomic structure and thermal stability of amorphous alloy $Zr_{65}Cu_{17,5}Ni_{10}Al_{7,5}$ at.%, which appears as one of the most perspective for practical use. Also studied were the amorphous alloys of the type Cu-Zr-Ti in terms of their preparation, mechanical and electrical properties, with regards to possible future application. The second group of materials researched as part of the project were materials with partially disordered structure; disperse strengthened nanocrystalline composites on the basis of copper and aluminium designed for high-temperature application in the electrotechnical and automobile industries.

"Development of New Generation Joints of Power Electronics Using Nonstandard Sn-Based Alloys", project APVV-14-0085 (2015-2018)

The aim of the project was the development of new types of non-standard lead-free soldering alloys based on Sn with a different content of intermetallic compounds, designed for quality soldering in the area of power electronics. The research team at ÚMV SAV are in this project responsible for the preparation and characterization of alloys of a new generation of links and joints for power electronics with heat resistance up to 200 °C.

2) Activities of IMR SAS in the field of **advanced structural ceramics and non-metallic materials** are summarized in the following overview:

2a) Modern structural ceramics and nanocomposites

Among the main results in the field of microstructure and properties of bulk composite and nanocomposite ceramic materials with carbon allotropes as fillers (graphene, carbon nanotubes, graphite, etc.) was the investigation of tribological properties of silicon nitride based nanocomposites with carbon nanophases in the frame of projects COST MP0701 a VEGA 2/0120/10. In collaboration with the Institute of Technical physics and Material Science of the Hungarian Academy of Sciences in Budapest a range of Si_3N_4 based nanocomposites with carbon nanotubes and with graphene nano-platelets was prepared and characterized. Among the first in the world we found and publish that the carbon nanoplatelets can significantly increase the fracture toughness of the silicon nitride and together with the CNTs they influence the tribological properties in such a way, that for the toughened materials the wear resistance improved. In the composites of Si_3N_4 with 3% of graphene the wear resistance increased three times when compared to the monolithic Si_3N_4. Higher amounts of CNT (above 3%) lead to lower coefficient of friction. In the case of Si_3N_4- 5%CNT for halved coefficient of friction also satisfactory wear rate was recorded.

2b) Nanomechanical measurements

In the field of micromechanical properties of ceramic materials our effort was, in the frame of projects 2/0122/12 and CE SAV CLTP-MREC, focused on investigation of anisotropy of mechanical properties of WC grains in WC-Co hardmetals. By means of measurement of deformation anisotropy in WC grains using the nanoindentation and compression of micro-pillars in WC-Co composites significantly higher hardness, elastic modulus and yield stress in basal grains than in the prismatic ones were found. The orientation dependent deformation mechanisms were related to the activation of {10-10} slip system. Activation of this system causes sink-in effect in basal plains and pile-up in prismatic ones. At the same time a theoretical model for description of hardness anisotropy and morphology in the vicinity of indent was proposed with respect to the sink-in effect, which is based on critical stress necessary for activation of dislocation slip in WC.

In the frame of the projects NanoCEXmat I, NanoCEXmat II, and CEKSIM, financed by the EU Structural Funds, as well as APVV 0161-11 and VEGA 2/0122/12 methodical questions of

micro/nano-indentation methods of testing of brittle materials were investigated in detail. By means of instrumented indentation at nano-level at applied loads from 0.25 mN to 50 mN the hardness, reduced modulus and indentation fatigue of individual WC-Co components were measured. Furthermore, the influence of indentation load, microstructure, heat treatment and crystallographic orientation of WC crystals/grains on their mechanical properties was investigated. It was clearly shown that in sufficiently fine grained materials the result of nanoindentation is often the so-called "combined" hardness, particularly if the indent is close to the Co/WC (binder/grain) interface. Heat treatment has only little effect on properties of both phases. During the indentation of WC grains clear load effect was found, but in the case of the Co binder it was absent. Important influence of crystallographic orientation of WC crystals on hardness, indentation modulus and indentation fatigue was caused by increased hardness and reduced modulus in the basal plane.

2c) Superhard PVD coating

In the research of hard PVD coatings prepared by pulse ionized sputtering with controlled tribological properties was in the frame of the projects VEGA 2/0108/11 and APVV-0520-10 studied the topic of improving of oxidation resistance and hardness of PE CVD W-C coatings. By optimization of deposition parameters in case of PE CVD WC coatings increase of hardness from usual 15-20 GPa up to 28.5 ± 2 GPa was achieved, at the coefficient of friction 0.77. The minimum coefficient of friction was 0.12 but hardness of coatings in this case fell down to 14.6 ± 1.7 GPa and Youngs modulus to 152 ± 7 GPa. The increase of coefficient of friction to 0.7 - 0.8 is connected to the lack of free carbon with lubricating effect and to the formation of iron oxides (from the counterpart - steel ball) and tungsten oxides due to tribochemical reactions in the contact of the surface micro-asperities. When using the precursor and C_2H_2 a nanocomposite structure of WC_{1-x} in carbon matrix is formed, which causes lower hardness but also significant reduction of friction coefficient. Combination of the precursor $W(CO)_6$ and N_2+SiH_4 mixture resulted in smaller decrease of hardness together with great lowering of coefficient of friction: at the optimized parameters of coating deposition the nanoindentation hardness was 26.9 ± 0,9 GPa, indentation modulus 221 ± 21 GPa, and coefficient of friction 0.35. In the case of W-C coatings deposited by DC magnetron sputtering maximum indentation hardness of 37.2 ± 4.8 GPa and indentation modulus 447 ± 28 GPa at coefficient of friction of 0.64 were achieved. At the same time the compressive residual stresses inside the coating were reduced to 0.5 GPa. For CrN coatings deposited by DC magnetron sputtering indentation hardness was 26.2 ± 2 GPa and indentation modulus 180 ± 28 GPa. The lowest coefficient of friction 0.2 was achieved for coatings with hardness of 22 GPa. While studying the residual stresses in W-C and Cr-N coatings it was found that the compressive stresses in coatings increase with increasing pressure and negative bias and decrease with increasing coating thickness. From the thickness of 1.4 mm they reach values below 1 GPa. Also, an increasing linear dependence of nanoindentation hardness (interval 16 GPa - 20 GPa) on compressive stress (interval from 1.75 GPa to 4.5 GPa) with the slope close to 1 was found.

2d) Modelling of bio-implants

In the area of investigation of properties of biological material were activities in project VEGA 2/0098/14 focused on modeling of stress states at mechanical loading in composite bone/implant system with various types of implant fixation. It was found that multi-axial loading of dental implant generates in the cortical bone compressive stresses concentrated in the root of the first implant thread. The shortening of the implant length and thinning of the cortical bone leads to great increase of maximum stresses in the cortical bone and shortening of the implant lifetime due to the bone degradation. Bi-cortical implant fixation brings only marginal reduction of stress concentration in comparison to the mono-cortical one. The maximum compressive stresses in the cortical bone and extension of the implant lifetime can be achieved more effectively by embedding the implant beneath the surface of cortical bone.

3) Activities of IMR SAS in the field of **hybrid materials, biomaterials and functional materials** can be summarized as follows:

3a) Hybrid materials

In the field of PM composites research was aimed at studying the compaction and properties of micro-composite soft magnetic composites. The result of research and development

of preparation technology and characterization of the microcomposite materials is a complex body of knowledge and methodologies applicable in the field of preparation of functional composite materials. The knowledge is available to contractors and interested parties from industry with the aim of intensification and optimization of existing production processes and as an impulse for the introduction of advanced production and characterization methods, especially in the field of electrical engineering. One of the outcomes in this area was a process of fabrication of magnetic composites with polymer electrically insulating binder, which was included among the most important results of the SAS for 2013.

New hybrid composites based on different ferromagnetic powder (Fe, FeSi, Vitroperm) and synthesized phenol-formaldehyde resin boron doped nanoparticles, adsorbents volatile $ZnSO_4$ and SiO_2 were prepared (project APVV-0222-10). Using microwave sintering technology were prepared magnetic composites based on Fe with the secondary components based on ferrites $NiZnFe_2O_4$, $MnZnFe_2O_4$ and $MgFe_2O_4$. Relationships between the geometry of ferromagnetic particles, the type and proportion of electrical insulating components and technology training were identified. It was found that the dominant factor determining the electric, magnetic, and mechanical properties is the percolation threshold. A contribution to the analysis of the overall pre-magnetization losses was developed, with emphasis on the proportion of anomalous losses. The validity of Steinmetz law for magnetic reversal of composite in quasi-static mode was investigated, and new contribution to its physical analysis was published.

3b) Biomaterials

In the field of characterization and preparation of calcium phosphate ceramic biomaterial systems the research was focused to develop applicable porous implants composed of the major hydroxyapatite phase and minor phases - β-tricalcium and α-tricalcium phosphates, and highly porous biomaterials with nanocrystalline microstructure (project SF EU 26220120066). There, according to the needs of practice it is possible to prepare implants in various sizes and shapes with porosity up to 75 vol. %, the maximum pore size of 500 microns, and the compression strength of 2-340 MPa, depending on the porosity of the implant. The research was specifically aimed at the application of these materials introducing of stem cells stimulating development and growth of new bone tissue, which was confirmed by the results of in-vivo tests on animal models of pigs in terms of bioactivity. The important contribution to the analysis of processes during crystallization of synthetic hydroxyapatite precipitates was the study of the substructure synthesized particles, reaffirming the strong effect of intramolecular water to breakage of the calcium phosphate apatite agglomerates into ordered apatite clusters and recrystallization of the amorphous matrix. Intramolecular water ensures the formation of hydrogen bonds that connect the extremely fine calcium phosphate clusters in the amorphous matrix, and simultaneously connecting together the matrix with the ordered regions. In the development of new types of calcium phosphate biocements we managed to develop a new process for preparing of tetracalcium phosphate biocement with nanocrystalline monetite with the final compressive strength of about 40 MPa and reduced pH in the cement paste to 8.4 (project VEGA 2/0047/14). The cement powder mixture was used for the preparation and testing of composite systems with the biopolymer component. The impact of changes in the surface characteristics of calcium phosphate on the proliferation of osteoblasts was analyzed in detail. A modified method of preparing two-component systems biopolymer based on chitosan / polyhydroxybutyrate was developed, and the relationship and interaction between the biopolymers were characterized in greater detail, where the essential result was the demonstration of reduction of the average molecular weight of the chitosan as a consequence of interaction with solution of polyhydroxybutyrate. This way it is possible to vary e.g. bactericidal or physical-chemical properties of the composites. The results of the in vitro test of the composites showed excellent cell proliferation with no evidence of cytotoxicity, which predicts their applicability in medicine in the reconstruction of soft tissues. To improve the properties of calcium phosphate biocement systems, attention was focused on the preparation of composites of calcium phosphate/bioglass, where the new advanced compositions based on brushite were being developed. Bioglass based two- and three-component phases of $CaO\text{-}SiO_2\text{-}P_2O_5$ powder systems were synthesized by specific procedure of rapid precipitation of water-soluble precursors. The results indicated a significant effect of the final pH of the calcium silicate-phosphate slurry during precipitation on the phase ordering in the precipitates. The precipitates phase composition was controlled by the ratio of Ca/P. It was found that the prepared $Ca_x(SiO_4)_y(PO_4)_z.nH_2O$ gels during synthesis act as hydrated calcium silicate gel wherein the ratio of Ca/Si is dependent on the pH of

the surrounding environment. Evaluation of the in vitro tests using osteoblasts led to the conclusion that the well developed texture and morphology of the hydroxyapatite particles during the initial stages of solidification greatly reduces the degree of transformation of the cement and of textural stability on the cell proliferation and cytotoxicity of cements. New two-phase systems brushite-CaSi bioglass or wollastonite, respectively, were studied, and the relationships between the increase of mechanical strength, setting time and addition and/or crystallinity of CaSi phase in the composite were characterized. It was demonstrated that the phase composition of the solidified cement depends on the initial Ca/P ratio regardless of the amount of SiO_2 in the systems and the significant effect of bioglass phases on ALP activity of osteoblasts was detected.

Further research was aimed at acquiring the knowledge concerning the preparation, mechanical properties, corrosion processes and biocompatibility of metallic biologically degradable materials prepared by powder metallurgy (project VEGA 2/0168/12). New types of powder mixtures prepared by mixing of various components (Fe-Mn, Fe-Mg, Fe-CNT, Fe-nano ZnO) or by coating of ferrous particles by layers of well defined compositions (Fe-P, Fe-Ag, Fe-PMMA, Fe-PPy) were prepared and characterized. Based on these specific biomaterials - cellular materials, metal foams and compacts were prepared. New knowledge about behaviour of these powders during pressing and sintering was obtained and new data of the microstructure of the materials prepared under different conditions were gathered. Also data about some mechanical properties of these materials (nano- and micro-hardness, modulus of elasticity, bending strength) were found. New knowledge on corrosion types and processes of the studied materials with connection to their chemical and phase composition, microstructure and method of preparation. The alloying elements lead to increase of degradation rate of the prepared biomaterials. Besides the traditional methods (long time immersion, potentio-dynamic polarization method) the corrosion processes were studied also by non-traditional ways (electro-chemical noise by means of fractal geometry). Low cytotoxicity of the extracts and haemocompatibility was confirmed for the selected materials in their initial state as well as when coated by bioceramic (hydroxyapatite) and/or polymer layers.

3c) Functional materials

The important research area are the lead-free ferroelectric (K, Na)NbO_3 (KNN) systems deposited on Pt/Al_2O_3 a Pt/SiO_2/Si substrates in the form of thin films with thickness up to 200 nm by the sol-gel/spin-coating method (project VEGA 2/0041/14). For the first time mechanical properties of sol-gel KNN films were determined by nanoindentation and the relationship between the phase composition and morphology of the film nanoparticles. The new synthesis of $La_{1/3}NbO_3$ (LN) and $La_{1/3}TaO_3$ (LT) precursors by complex polymer sol-gel method by means of Nb and Ta-tartaric complexes with calcination at low temperatures 750-1050°C was developed. In the films the co-existence of minor phases at 900°C was confirmed, namely monoclinic pyrochlore $LaTaO_4$ and perovskite $La_{1/3}TaO_3$ as well as their connection to the majority orthorhombic $La_{4.67}Ta_{22}O_{62}$ phase. In the sol-gel LT tartaric precursors at 1050°C was for the first time confirmed the presence of perovskite $La_{1/3}TaO_3$ phase and the multidomain structure of the superlattice of $La_{2/3}Ta_2O_9$. Primary studies of mechanical properties of various lanthanum niobate pyrochlores ($LaNbO_4$ and $LaNb_5O_{14}$) thin films were carried out. The important effect of the solvent during the gels preparation on mechanical properties was verified. The systems prepared in methanol had high hardness and elasticity modulus (~ 2.6 GPa and ~ 45 GPa, resp.) in comparison with those prepared in ethanol (~ 1.5 GPa and ~ 30 GPa, resp.).

From the point of view of ferroics and multiferroics as the most attractive multifunctional materials, the research was focused on novel multifunctional materials showing simultaneously ferroelectric and magnetic properties at room temperature (project VEGA2/0057/14). A partial substitution of isovalent dysprosium and terbium for bismuth at the A-sites of bismuth ferrite ($BiFeO_3$) was shown to improve phase purity and enhance multiferroic properties. The results of structural and physical property measurements showed that the appearance and enhancement of the magnetization in the rare-earth substituted $BiFeO_3$ ceramics can be correlated with the composition-driven structural phase transition. Besides, the direct electrocaloric effect (ECE) measurements on $(Na_{0.5}Ba_{0.5})TiO_3$ - $0.6BaTiO_3$ bulk ceramics up to 50 kV/cm while doping the A-site of perovskite with Ca and Li showed that the combination of several A-site dopings can bring the ECE enhancement closer to room temperature. This allows the use of the materials with the highest ECE performances without any loss in efficiency for household refrigeration as well as for on-chip cooling in advanced electronics.

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 (ratios 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 listed for the assessment period should not exceed the average number of employees with university degrees engaged in research projects. The principal research outputs (max. 5, including Digital Object Identifier - DOI) should be underlined

1. YANG, L. - GUO, G.Q. - CHEN, L.Y. - HUANG, C.L. - GE, T. - CHEN, D.-X. - LIAW, P.K. - SAKSL, Karel - REN, Y. - ZENG, Q.S. - LAQUA, B. - CHEN, F.G. - JIANG, J.Z. Atomic-scale mechanisms of the glass-forming ability in metallic glasses. In *Physical Review Letters*, 2012, vol. 109, 105502. (**7.370 - IF2011**)
   DOI: 10.1038/srep04648

2. KOBERA, Libor - CZERNEK, Jiří - STREČKOVÁ, Magdaléna - URBANOVÁ, Martina - ABBRENT, Sabina - BRUS, Jiří. Structure and distribution of cross-links in boron-modified phenol-formaldehyde resins designed for soft magnetic composites: A multiple-quantum 11B-11B MAS NMR correlation spectroscopy study. In *Macromolecules*, 2015, vol. 48, no. 14, p. 4874-4881. (**5.800 - IF2014**)
   DOI: 10.1021/acs.macromol.5b01037

3. 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. (**5.578 - IF2014**)
   DOI: 10.1038/srep09953

4. 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. (**4.835 - IF2013**).
   DOI: 10.1021/jp500609h

5. CSANÁDI, Tamás - BĽANDA, Marek - CHINH, Nguyen Quang - HVIZDOŠ, Pavol - DUSZA, Ján. Orientation-dependent hardness and nanoindentation-induced deformation mechanisms of WC crystals. In *Acta Materialia*, 2015, vol. 83, p. 397-407. (**4.465 - IF2014**)
   DOI: 10.1016/j.actamat.2014.09.048

6. GIEWEKEMEYER, K. - HACKENBERG, C. - AQUILA, A. - WILKE, R.N. - GROVES, M.R. - JORDANOVA, R. - LAMZIN, V.S. - BORCHERS, G. - SAKSL, Karel - ZOZULYA, A.V. - SPRUNG, M. - MANCUSO, A.P. Tomography of a cryo-immobilized yeast cell using ptychographic coherent x-ray diffractive imaging. In *Biophysical Journal*, 2015, vol. 109, p. 1986-1995. (**3.972 - IF2014**)
   DOI: 10.1016/j.bpj.2015.08.047

7. KABAN, I. - JÓVÁRI, P. - KOKOTIN, V. - SHULESHOVA, O. - BEUNEU, B. - SAKSL, Karel - MATTERN, N. - ECKERT, J. - GREER, A.L. Local atomic arrangements and their topology in Ni-Zr and Cu-Zr glassy and crystalline alloys. In *Acta Materialia*, 2013,

vol. 61, p. 2509-2520. (**3.941 - IF2012**)

8. SAEIDI, Kamran - KVETKOVÁ, Lenka - LOFAJ, František - SHEN, Zhijian. Austenitic stainless steel strengthened by the in situ formation of oxide nanoinclusions. In *RSC Advances*, 2015, vol. 5, p. 20747-20750. (**3.840 - IF2014**)

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. (**3.769 - IF20**14)

10. GALUSKOVÁ, Dagmar - KAŠIAROVÁ, Monika - HNATKO, Miroslav - GALUSEK, Dušan - DUSZA, Ján - ŠAJGALÍK, Pavol. Hydrothermal corrosion and flexural strength of Si3N4-based ceramics. In *Corrosion Science*, 2014, vol. 85, p. 94-100**. (3.686 - IF2013**)

11. MEDVECKÝ, Ľubomír - GIRETOVÁ, Mária - ŠTULAJTEROVÁ, Radoslava - KAŠIAROVÁ, Monika. Effect of microstructure characteristics on tetracalcium phosphate-nanomonetite cement in vitro cytotoxicity. In Biomedical Materials, 2015, vol. 10, 025006. (3.697 - IF2014). ISSN 1748-6041.
DOI: 10.1088/1748-6041/10/2/025006

12. STREČKOVÁ, Magdaléna - SOPČÁK, Tibor - MEDVECKÝ, Ľubomír - BUREŠ, Radovan - FÁBEROVÁ, Mária - BAŤKO, Ivan - BRIANČIN, Jaroslav. Preparation, chemical and mechanical properties of microcomposite materials based on Fe powder and phenol-formaldehyde resin. In *Chemical Engineering Journal*, 2012, vol. 180, p. 343-353. (**3.461 - IF2011**)
DOI: 10.1016/j.cej.2011.11.036

13. GAUDIN, Jérôme - OZKAN, Cigdem - CHALUPSKÝ, Jaromír - BAJT, Saša - BURIAN, Tomáš - VYŠÍN, Luděk - COPPOLA, Nicola - FARAHANI, Shafagh Dastjani - CHAPMAN, Henry N. - GALASSO, Germano - HÁJKOVÁ, Věra - HARMAND, Marion - JUHA, Libor - JUREK, Marek - LOCH, Rolf A. - MÖLLER, Stefan - NAGASONO, Mitsuru - STÖRMER, Michael - SINN, Harald - SAKSL, Karel - SOBIERAJSKI, Ryszard - SCHULZ, Joachim - SOVÁK, Pavol - TOLEIKIS, Sven - TIEDTKE, Kai - TSCHENTSCHER, Thomas - KRZYWINSKI, Jacek. Investigating the interaction of x-ray free electron laser radiation with grating structure. In *Optics Letters*, 2012, vol. 37, no. 15, p. 3033-3035. (**3.399 - IF2011**)

14. CHICARDI, E. - TORRES, Y. - CÓRDOBA, J.M. - HVIZDOŠ, Pavol - GOTOR, Francisco José. Effect of tantalum content on the microstructure and mechanical behavior of cermets based on (TixTa1-x)(C0.5N0.5) solid solutions. In *Materials and Design*, 2014, vol. 53, p. 435-444. (**3.171 - IF2013**)

15. LOFAJ, František - KUČERA, Ján - NÉMETH, Dušan - KVETKOVÁ, Lenka. Finite element analysis of stress distributions in mono- and bi-cortical dental implants. In *Materials Science and Engineering C - Biomimetic and Supramolecular Systems*, 2015, vol. 50, p. 85-96. (**3.088 - IF2014**)
DOI: 10.1016/j.msec.2015.01.095

16. ĎURIŠINOVÁ, Katarína - ĎURIŠIN, Juraj - OROLÍNOVÁ, Mária - ĎURIŠIN, Martin - SZABÓ, Juraj. Effect of mechanical milling on nanocrystalline grain stability and properties of Cu-Al2O3 composite prepared by thermo-chemical technique and hot extrusion. In *Journal of Alloys and Compounds*, 2015, vol. 618, p. 204-209. (**2.999 - IF2014**)
DOI: 10.1016/j.jallcom.2014.08.177

17. 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. (**2.999 - IF2014**)

18. BIRČÁKOVÁ, Zuzana - KOLLÁR, P. - WEIDENFELLER, Bernd - FÜZER, J. - FÁBEROVÁ, Mária - BUREŠ, Radovan. Reversible and irreversible DC magnetization processes in the frame of magnetic, thermal and electrical properties of Fe-based composite materials. In *Journal of Alloys and Compounds*, 2015, vol. 645, p. 283-289. (**2.999 - IF2014**)

19. TEGNER, B.E. - ZHU, L. - SIEMERS, Carsten - SAKSL, Karel - ACKLAND, G.J. High temperature oxidation resistance in titanium-niobium alloys. In *Journal of Alloys and Compounds*, 2015, vol. 643, p. 100-105. (**2.999 - IF2014**)

20. BURIAN, Tomáš - HÁJKOVÁ, V. - CHALUPSKÝ, Jaromír - VYŠÍN, Luděk - BOHÁČEK, Pavel - PŘEČEK, Martin - WILD, Jan - ÖZKAN, Cigdem - COPPOLA, Nicola - FARAHANI, Shafagh Dastjani - SCHULZ, Joachim - SINN, Harald - TSCHENTSCHER, Thomas - GAUDIN, Jérôme - BAJT, Saša - TIEDTKE, Kai - TOLEIKIS, Sven - CHAPMAN, Henry N. - LOCH, Rolf A. - JUREK, Marek - SOBIERAJSKI, Ryszard - KRZYWINSKI, Jacek - MOELLER, Stefan - HARMAND, Marion - GALASSO, Germano - NAGASONO, Mitsuru - SAKSL, Karel - SOVÁK, Pavol - JUHA, Libor. Soft x-ray free-electron laser induced damage to inorganic scintillators. In *Optical Materials Express*, 2015, vol. 5, no. 2, p. 254-264. (**2.844 - IF2014**)

21. ĎURIŠIN, Juraj Jr. - BALGA, Dušan - SAKSL, Karel - PIETRIKOVÁ, A. Atomic structure of Cu-Zr-Ti metallic glasses subjected to high temperature annealing. In *Journal of Alloys and Compounds*, 2014, vol. 608, p. 241-246. (**2.726 - IF2013**)

22. 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. (**2.699 - IF2011**)

23. CSANÁDI, Tamás - CHINH, Nguyen Quang - SZOMMER, Péter - DUSZA, Ján - LENČÉŠ, Zoltán - ŠAJGALÍK, Pavol. Deformation and fracture of β-silicon nitride micropillars. In *Journal of the American Ceramic Society*, 2015, vol. 98, no. 2, p. 374-377. (**2.610 - IF2014**)

24. ŠPÍRKOVÁ, Milena - DUSZOVÁ, Annamária - POREBA, Rafal - KREDATUSOVÁ, Jana - BUREŠ, Radovan - FÁBEROVÁ, Mária - ŠLOUF, Miroslav. Thermoplastic polybutadiene-based polyurethane/carbon nanofiber composites. In *Composites Part B: Engineering*, 2014, vol. 67, p. 434-440. (**2.602 - IF2013**)

25. ŠTULAJTEROVÁ, Radoslava - MEDVECKÝ, Ľubomír - GIRETOVÁ, Mária - SOPČÁK, Tibor. Structural and phase characterization of bioceramics prepared from tetracalcium phosphate-monetite cement and in vitro osteoblast response. In *Journal of Materials Science: Materials in Medicine*, 2015, vol. 26, p. 183-191. (**2.587 - IF2014**)

26. DOBEŠ, Ferdinand - DYMÁČEK, Petr - BESTERCI, Michal. Estimation of the mechanical properties of aluminium and an aluminium composite after equal channel angular pressing by means of the small punch test. In *Materials Science and Engineering A - Structural Materials Properties Microstructure and Processing*, 2015, vol. 626, p. 313-321. (**2.567 - IF2014**)

27. PARCIANELLO, G. - BERNARDO, E. - COLOMBO, P. - LENČÉŠ, Zoltán - VETRECIN, Michal - ŠAJGALÍK, Pavol - KAŠIAROVÁ, Monika. Preceramic polymer-derived SiAlON as sintering aid for silicon nitride. In *Journal of the American Ceramic Society*, 2014, vol. 97, no. 11, p. 3407-3412. (**2.428 - IF2013**)

28. KOVAĽ, Vladimír - ŠKORVÁNEK, Ivan - YAN, Haixue. Low-temperature magnetic and dielectric anomalies in rare-earth-substituted BiFeO3 ceramics. In *Journal of the American Ceramic Society*, 2014, vol. 97, no. 12, p. 3729-3732. (**2.428 - IF2013**)

29. SAKSL, Karel - ROKICKI, Pawel - SIEMERS, Carsten - OSTROUSHKO, Dmytro - BEDNARČÍK, J. - RÜTT, Uta. Local structure of metallic chips examined by X-ray microdiffraction. In *Journal of Alloys and Compounds*, 2013, vol. 581, p. 579-584. (**2.390 - IF2012**)

30. MEDVECKÝ, Ľubomír - GIRETOVÁ, Mária - ŠTULAJTEROVÁ, Radoslava. Properties and in vitro characterization of polyhydroxybutyrate-chitosan scaffolds prepared by modified precipitation method. In *Journal of Materials Science: Materials in Medicine*, 2014, vol. 25, p. 777-789. (**2.379 - IF2013**)

31. BRUNCKOVÁ, Helena - MEDVECKÝ, Ľubomír - HVIZDOŠ, Pavol - ĎURIŠIN, Juraj - GIRMAN, Vladimír. Structural and mechanical properties of sol-gel prepared pyrochlore lanthanum niobates. In *Journal of Materials Science*, 2015, vol. 50, p. 7197-7207. (**2.371 - IF2014**)

32. 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. (**2.360 - IF2012**)

33. LOFAJ, František - MOSKALEWICZ, Tomasz - CEMPURA, Gregorz - MIKULA, Marian - DUSZA, Ján - CZYRSKA-FILEMONOWICZ, Aleksandra. Nanohardness and tribological properties of nc-TiB2 coatings. In *Journal of the European Ceramic Society*, 2013, vol.33, p.2347-2353. (**2.360 - IF2012**)

34. PARCHOVIANSKÝ, Milan - GALUSEK, Dušan - SEDLÁČEK, Jaroslav - ŠVANČÁREK, Peter - KAŠIAROVÁ, Monika - DUSZA, Ján - ŠAJGALÍK, Pavol. Microstructure and mechanical properties of hot pressed Al2O3/SiC nanocomposites. In *Journal of the European Ceramic Society*, 2013, vol. 33, no. 12, p. 2291-2298. (**2.360 - IF2012**)

35. KVETKOVÁ, Lenka - DUSZOVÁ, Annamária - KAŠIAROVÁ, Monika - DORČÁKOVÁ, Františka - DUSZA, Ján - BALÁZSI, Csaba. Influence of processing on fracture toughness of Si3N4 + graphene platelet composites. In *Journal of the European Ceramic Society*, 2013, vol. 33, p. 2299-2304. (**2.360 - IF2012**)

36. TATARKO, Peter - KAŠIAROVÁ, Monika - DUSZA, Ján - ŠAJGALÍK, Pavol. Influence of rare-earth oxide additives on the oxidation resistance of Si3N4-SiC nanocomposites. In *Journal of the European Ceramic Society*, 2013, vol. 33, p. 2259-2268. (**2.360 - IF2012**)

37. DUSZOVÁ, Annamária - HALGAŠ, Radoslav - BĽANDA, Marek - HVIZDOŠ, Pavol - LOFAJ, František - DUSZA, Ján - MORGIEL, Jerzy. Nanoindentation of WC-Co hardmetals. In *Journal of the European Ceramic Society*, 2013, vol. 33, p. 2227-2232. (**2.360 - IF2012**)

38. 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. (**2.353 - IF2011**)

39. KOVAĽ, Vladimír - ŠKORVÁNEK, Ivan - REECE, Michael J. - MITOSERIU, L. - YAN, Haixue. Effect of dysprosium substitution on crystal structure and physical properties of multiferroic BiFeO3 ceramics. In *Journal of the European Ceramic Society*, 2014, vol. 34, no. 3, p. 641-651. (**2.307 - IF2013**)

40. KOVALČÍKOVÁ, Alexandra - BALKO, Ján - BALÁZSI, Csaba - HVIZDOŠ, Pavol - DUSZA, Ján. Influence of hBN content on mechanical and tribological properties of Si3N4/BN ceramic composites. In *Journal of the European Ceramic Society*, 2014, vol. 34, p. 3319-3328. (**2.307 - IF2013**)

41. BALKO, Ján - HVIZDOŠ, Pavol - DUSZA, Ján - BALÁZSI, Csaba - GAMCOVÁ, Jana. Wear damage of Si3N4-graphene nanocomposites at room and elevated temperatures. In *Journal of the European Ceramic Society*, 2014, vol. 34, p. 3309-3317. (**2.307 - IF2013**)

42. MICHÁLEK, Martin - KAŠIAROVÁ, Monika - MICHÁLKOVÁ, Monika - GALUSEK, Dušan. Mechanical and functional properties of Al2O3-ZrO2-MWCNTs nanocomposites. In *Journal of the European Ceramic Society*, 2014, vol. 34, p. 3329-3337. (**2.307 - IF2013**)

43. MICHÁLKOVÁ, Monika - KAŠIAROVÁ, Monika - TATARKO, Peter - DUSZA, Ján - ŠAJGALÍK, Pavol. Effect of homogenization treatment on the fracture behaviour of silicon nitride/graphene nanoplatelets composites. In *Journal of the European Ceramic Society*, 2014, vol. 34, no. 14, p. 3291-3299. (**2.307 - IF2013**)

44. KAŠIAROVÁ, Monika - TATARKO, Peter - BURIK, Peter - DUSZA, Ján - ŠAJGALÍK, Pavol. Thermal shock resistance of Si3N4 and Si3N4-SiC ceramics with rare-earth oxide sintering additives. In *Journal of the European Ceramic Society*, 2014, vol. 34, no. 14, p. 3301-3308. (**2.307 - IF2013**)

45. BĽANDA, Marek - DUSZOVÁ, Annamária - CSANÁDI, Tamás - HVIZDOŠ, Pavol - LOFAJ, František - DUSZA, Ján. Indentation fatigue of WC grains in WC-Co composite. In *Journal of the European Ceramic Society*, 2014, vol. 34, p. 3407-3412. (**2.307 - IF2013**)

46. CSANÁDI, Tamás - BĽANDA, Marek - DUSZOVÁ, Annamária - CHINH, Nguyen Quang - SZOMMER, Péter - DUSZA, Ján. Deformation characteristics of WC micropillars. In *Journal of the European Ceramic Society*, 2014, vol. 34, p. 4099-4103. (**2.307 - IF2013**)

47. TATARKO, Peter - GRASSO, Salvatore - CHLUP, Zdeněk - PORWAL, Harshit - KAŠIAROVÁ, Monika - DLOUHÝ, Ivo - REECE, Michael J. Toughening effect of multi-walled boron nitride nanotubes and their influence on the sintering behaviour of 3Y-TZP zirconia ceramics. In *Journal of the European Ceramic Society*, 2014, vol. 34, p. 1829-1843. (**2.307 - IF2013**)

48. BRUNCKOVÁ, Helena - MEDVECKÝ, Ľubomír - ĎURIŠIN, Juraj - HVIZDOŠ, Pavol - GIRMAN, Vladimír. Structural properties and phase transformation of sol-gel prepared lanthanum tantalates. In *Journal of Materials Science*, 2014, vol. 49, p. 8423-8435. (**2.305 - IF2013**)

49. ĎURIŠINOVÁ, Katarína - ĎURIŠIN, Juraj - OROLÍNOVÁ, Mária - ĎURIŠIN, Martin. Effect of particle additions on microstructure evolution of aluminium matrix composite. In *Journal of Alloys and Compounds*, 2012, vol. 525, p. 137-142. (**2.289 - IF2011**)

50. HOMOLOVÁ, Viera - KROUPA, Aleš - VÝROSTKOVÁ, Anna. Calculation of Fe-B-V ternary phase diagram. In *Journal of Alloys and Compounds*, 2012, vol. 520, p. 30-35. (**2.289 - IF2011**)

51. BRUNCKOVÁ, Helena - MEDVECKÝ, Ľubomír - ĎURIŠIN, Juraj - GIRMAN, Vladimír. Phase transformation and particle morphology of perovskite La1/3TaO3 precursors prepared by polymeric tartrate complex sol-gel method. In *Materials Letters*, 2014, vol. 115, p. 184-186. (**2.269 - IF2013**)

52. MEDVECKÝ, Ľubomír - GIRETOVÁ, Mária - SOPČÁK, Tibor. Preparation and properties of tetracalcium phosphate-monetite biocement. In *Materials Letters*, 2013, vol. 100, p. 137-140. (**2.224 - IF2012**)

53. STREČKOVÁ, Magdaléna - MEDVECKÝ, Ľubomír - FÜZER, J. - KOLLÁR, P. - BUREŠ, Radovan - FÁBEROVÁ, Mária. Design of novel soft magnetic composites based on Fe/resin modified with silica. In *Materials Letters*, 2013, vol. 101, p. 37-40. (**2.224 - IF2012**)

54. PIKNA, Ľubomír - MILKOVIČ, Ondrej - SAKSL, Karel - HEŽELOVÁ, Mária - SMRČOVÁ, Miroslava - PULIŠ, Pavel - MICHALIK, Štefan - GAMCOVÁ, Jana. The structure of nano-palladium deposited on carbon-based supports. In *Journal of Solid State Chemistry*, 2014, vol. 212, p. 197-204. (**2.200 - IF2013**)

55. ZELEŇÁKOVÁ, Adriana - ZELEŇÁK, Vladimír - MAŤKO, Igor - STREČKOVÁ, Magdaléna - HRUBOVČÁK, Pavol - KOVÁČ, Jozef. Superferromagnetism in chain-like Fe@SiO2 nanoparticle ensembles. In *Journal of Applied Physics*, 2014, vol. 116, 033907. (**2.185 - IF2013**)

56. STREČKOVÁ, Magdaléna - FÜZER, J. - KOBERA, Libor - BRUS, Jiří - FÁBEROVÁ, Mária - BUREŠ, Radovan - KOLLÁR, P. - LAUDA, M. - MEDVECKÝ, Ľubomír - GIRMAN, Vladimír - HADRABA, Hynek - BAŤKOVÁ, Marianna - BAŤKO, Ivan. A comprehensive study of soft magnetic materials based on FeSi spheres and polymeric resin modified by silica nanorods. In *Materials Chemistry and Physics*, 2014, vol. 147, p. 649-660. (**2.129 - IF2013**)

57. KOTTFER, Daniel - FERDINANDY, Milan - KACZMAREK, Lukasz - MAŇKOVÁ, Ildikó - BEŇO, J. Investigation of Ti and Cr based PVD coatings deposited onto HSS Co 5 twist drills. In *Applied Surface Science*, 2013, vol. 282, p. 770-776. (**2.112 - IF2012**)

58. MEDVECKÝ, Ľubomír - SOPČÁK, Tibor - GIRMAN, Vladimír - BRIANČIN, Jaroslav. Amorphous calcium phosphates synthesized by precipitation from calcium D-gluconate solutions. In *Colloids and Surfaces A : Physicochemical and Engineering Aspects*, 2013, vol. 417, p. 191-200. (**2.108 - IF2012**)

59. ROSENBERG, Gejza - SINAIOVÁ, Iveta - JUHÁR, Ľuboš. Effect of microstructure on mechanical properties of dual phase steels in the presence of stress concentrators. In *Materials Science and Engineering A - Structural Materials Properties Microstructure and Processing*, 2013, vol. 582, p. 347-358. (**2.108 - IF2012**)

60. AZHNIUK, Y.M. - STOYKA, Volodymyr - PETRYSHYNETS, Ivan - RUBISH, V.M. - GURANICH, O.G. - GOMONNAI, A.V. - ZAHN, D.R.T. SbSI nanocrystal formation in As-Sb-S-I glass under laser beam. In *Materials Research Bulletin*, 2012, vol. 47, p. 1520-1522. (**2.105 - IF2011**)

61. JAKUBÉCZYOVÁ, Dagmar - HVIZDOŠ, Pavol - SELECKÁ, Marcela. Investigation of thin layers deposited by two PVD techniques on high speed steel produced by powder metallurgy. In *Applied Surface Science*, 2012, vol. 258, p. 5105-5110. (**2.103 - IF2011**)

62. LOFAJ, František - FERDINANDY, Milan - CEMPURA, Gregorz - DUSZA, Ján. Nanoindentation, AFM and tribological properties of thin nc-WC/a-C coatings. In *Journal of the European Ceramic Society*, 2012, vol. 32, p. 2043-2051. (**2.353 - IF2011**)

2.1.3 List of monographs/books published abroad

1. ŠALAK, Andrej - SELECKÁ, Marcela. *Manganese in powder metallurgy steels*. Cambridge : Cambridge International Science Publishing, 2012. 477 p. ISBN 978-1-907343-74-2.

2. CENIGA, Ladislav. *Analytical models of thermal stresses in composite materials IV*. Nova Science Publishers, 2015. 207 p. ISBN 978-1-63463-780-3.

3. BESTERCI, Michal. *Nanostructural Al composites : Mechanical alloying, microstructure and mechanical properties of micro- and nanostructural Al-Al4C3 composites*. Saarbrücken : LAP LAMBERT Academic Publ., 2015. 143 p. ISBN 978-3-659-77387-7.

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

1. PARCHOVIANSKÝ, Milan - GALUSEK, D. - MICHÁLEK, M. - ŠVANČÁREK, P. - KAŠIAROVÁ, Monika - DUSZA, Ján - HNATKO, Miroslav. Effect of the volume fraction of SiC on the microstructure and creep behavior of hot pressed Al2O3/SiC composites. In *Ceramics International*, 2014, vol. 40, p. 1807-1814. (**2.086 - IF2013**)

2. PORWAL, Harshit - TATARKO, Peter - SAGGAR, Richa - GRASSO, Salvatore - KUMAR MANI, Mahesh - DUSZA, Ján - REECE, Michael J. Tribological properties of silica-graphene nano-platelet composites. In *Ceramics International*, 2014, vol. 40, p. 12067-12074. (**2.086 - IF2013**)

3. DOBEŠ, Ferdinand - BESTERCI, Michal - BALLÓKOVÁ, Beáta - SÜLLEIOVÁ, Katarína - DYMÁČEK, Petr. Analysis of creep fracture in Al-Al4C3 composite after ECAP. In *Materials Science and Engineering A - Structural Materials Properties Microstructure and Processing*, 2012, vol. 532, p. 567-572. (**2.003 - IF2011**)

4. KOLLÁR, P. - VOJTEK, Vladimír - BIRČÁKOVÁ, Zuzana - FÜZER, J. - FÁBEROVÁ, Mária - BUREŠ, Radovan. Steinmetz law in iron-phenolformaldehyde resin soft magnetic composites. In *Journal of Magnetism and Magnetic Materials*, 2014, vol. 353, p. 65-70. (**2.002 - IF2013**)

5. STREČKOVÁ, Magdaléna - HADRABA, Hynek - BUREŠ, Radovan - FÁBEROVÁ, Mária - ROUPCOVÁ, Pavla - KUBĚNA, Ivo - MEDVECKÝ, Ľubomír - GIRMAN, Vladimír - KOLLÁR, P. - FÜZER, J. - ČIŽMÁR, E. Chemical synthesis of nickel ferrite spinel designed as an insulating bilayer coating on ferromagnetic particles. In *Surface and coatings technology*, 2015, vol. 270, p. 66-76. (**1.998 - IF2014**)

6. HVIZDOŠ, Pavol - BALKO, Ján - CÓRDOBA, J.M. - CHICARDI, E. Nanoindentation of (Ti,Ta)(C,N)-Co cermets prepared by methods of mechanochemistry. In *International Journal of Refractory Metals and Hard Materials*, 2015, vol. 49, p. 219-224. (**1.989 - IF2014**)

7. BĽANDA, Marek - DUSZOVÁ, Annamária - CSANÁDI, Tamás - HVIZDOŠ, Pavol - LOFAJ, František - DUSZA, Ján. Indentation hardness and fatigue of the constituents of WC-Co composites. In *International Journal of Refractory Metals and Hard Materials*, 2015, vol. 49, p. 178-183. (**1.989 - IF2014**)

8. CSANÁDI, Tamás - NOVÁK, Michal - DUSZOVÁ, Annamária - DUSZA, Ján. Anisotropic nanoscratch resistance of WC grains in WC-Co composite. In *International*

Journal of Refractory Metals and Hard Materials, 2015, vol. 51, p. 188-191. (**1.989 - IF2014**)

9. KOLLÁR, P. - BIRČÁKOVÁ, Zuzana - VOJTEK, Vladimír - FÜZER, J. - BUREŠ, Radovan - FÁBEROVÁ, Mária. Dependence of demagnetizing fields in Fe-based composite materials on magnetic particle size and the resin content. In *Journal of Magnetism and Magnetic Materials*, 2015, vol. 388, p. 76-81. (**1.970 - IF2014**)

10. VARCHULOVÁ NOVÁKOVÁ, Zuzana - ORIŇÁKOVÁ, Renáta - ORIŇÁK, Andrej - HVIZDOŠ, Pavol - FEDORKOVÁ, Andrea. Elimination voltammetry as a new method for studying the SAM formation. In *International Journal of Electrochemical Science*, 2014, vol. 9, p. 3846-3863. (**1.956 - IF2013**)

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

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

Reported inventions

PV number: PP 00049-2012
The names of authors: Medvecký Ľubomír
Title of the invention: Spôsob prípravy prekurzorovej zmesi kalcium fosfátových cementov
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

PV number: PP 00091-2012
The names of authors: Kováč František, Petryshynets Ivan
Title of the invention: Zrnovo orientovaná elektrotechnická oceľ mikrolegovaná vanádom a spôsob jej výroby
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

PV number: PP 00095-2013
The names of authors: Bureš Radovan, Strečková Magdaléna, Fáberová Mária, Kollár Peter, Füzer Ján
Title of the invention: Spôsob prípravy magnetických kompozitov s polymérnym elektroizolačným spojivom
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

PV number:PP00089-2014
The names of authors:Medvecký Ľubomír, Giretová Mária, MVDr. Eva Petrovová, PhD.
Title of the invention: Biopolymérny kompozitný systém na regeneráciu chrupavky
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

PV number: SK 288278 B6
The names of authors: Ferdinandy Milan, Dusza Ján, Lofaj František, Kottfer Daniel
Title of the invention: Spôsob a zariadenie na povrchovú úpravu vnútorných plôch rotačných telies
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

PV number: PP 00090-2015
The names of authors: Kováč František, Petryshynets Ivan
Title of the invention: Vysokopevná izotrópna elektrotechnická oceľ s kompozitnou mikroštruktúrou
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

Inventions for which a patent was issued
PV number: 288155
The names of authors: Ferdinandy Milan, Dusza Ján, Lofaj František, Hegedüsová Lucia, Kottfer Daniel Doc. Ing. PhD.
Title of the invention: Zariadenie na prípravu vrstiev karbidov, nitridov, silicidov, boridov W, Cr, Mo, Re, Os, Rh, Ru a multivrstvových a kompozitných štruktúr na vnútornej valcovej ploche elektricky vodivej rúry
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

PV number: 288254
The names of authors: Ferdinandy Milan, Dusza Ján, Lofaj František, Kottfer Daniel, Doc. Ing. PhD.
Title of the invention: Zariadenie na vytváranie ochranných vrstiev na vnútorných plochách rotačných telies odparovaním látky elektrickým lúčom
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

PV number: 288322
The names of authors: Kováč František, Petryshynets Ivan, Stoyka Vladimír, Škorvánek Ivan, prof. Ing. Kvačkaj Tibor, CSc.
Title of the invention: Spôsob výroby izotrópnych elektrotechnických ocelí s nízkymi wattovými stratami
Owner / co-owner: Ústav materiálového výskumu SAV Košice (Institute of Materials Research of SAS Košice)

2.1.8. Table of research outputs (as in annual reports).

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	2012			2013			2014			2015			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
Scientific monographs and monographic studies in journals and proceedings published abroad *(AAA, ABA)*	1,0	0,016	0,002	0,0	0,000	0,000	0,0	0,000	0,000	2,0	0,033	0,003	3,0	0,8	0,012	0,001
Scientific monographs and monographic studies in journals and proceedings published in Slovakia *(AAB, ABB)*	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,0	0,000	0,000
Chapters in scientific monographs published abroad *(ABC)*	0,0	0,000	0,000	1,0	0,016	0,002	0,0	0,000	0,000	7,0	0,114	0,011	8,0	2,0	0,032	0,003
Chapters in scientific monographs published in Slovakia *(ABD)*	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,000	0,000	0,0	0,0	0,000	0,000
Scientific papers published in journals registered in Current Contents Connect *(ADCA, ADCB, ADDA, ADDB)*	38,0	0,620	0,064	39,0	0,643	0,075	56,0	0,863	0,093	49,0	0,801	0,079	182,0	45,5	0,733	0,078
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS *(ADMA, ADMB, ADNA, ADNB)*	15,0	0,245	0,025	4,0	0,066	0,008	37,0	0,570	0,062	22,0	0,359	0,036	78,0	19,5	0,314	0,033
Scientific papers published in other foreign journals (not listed above) *(ADEA, ADEB)*	7,0	0,114	0,012	4,0	0,066	0,008	6,0	0,092	0,010	2,0	0,033	0,003	19,0	4,8	0,077	0,008
Scientific papers published in other domestic journals (not listed above) *(ADFA, ADFB)*	18,0	0,293	0,030	32,0	0,527	0,061	16,0	0,246	0,027	11,0	0,180	0,018	77,0	19,3	0,310	0,033
Scientific papers published in foreign peer-reviewed proceedings *(AEC, AECA)*	12,0	0,196	0,020	8,0	0,132	0,015	12,0	0,185	0,020	0,0	0,000	0,000	32,0	8,0	0,129	0,014
Scientific papers published in domestic peer-reviewed proceedings *(AED, AEDA)*	11,0	0,179	0,018	27,0	0,445	0,052	7,0	0,108	0,012	0,0	0,000	0,000	45,0	11,3	0,181	0,019
Published papers (full text) from foreign and international scientific conferences *(AFA, AFC, AFBA, AFDA)*	18,0	0,293	0,030	12,0	0,198	0,023	13,0	0,200	0,022	20,0	0,327	0,032	63,0	15,8	0,254	0,027
Published papers (full text) from domestic scientific conferences *(AFB, AFD, AFBB, AFDB)*	4,0	0,065	0,007	1,0	0,016	0,002	7,0	0,108	0,012	33,0	0,539	0,053	45,0	11,3	0,181	0,019

- **Supplementary information and/or comments on the scientific outputs of the institute.**

2.2. Responses to the research outputs (citations, etc.)

2.2.1. Table with citations per annum.

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) have to be listed separately.

Citations, reviews	2011		2012		2013		2014		total		
	number	No. / FTE	number	No. / FTE	number	No. / FTE	number	No. / FTE	number	averaged number per year	av. No. / FTE
Citations in Web of Science Core Collection (1.1, 2.1)	282,0	4,598	305,0	5,025	308,0	4,745	387,0	6,322	1282,0	320,5	5,166
Citations in SCOPUS (1.2, 2.2) if not listed above	48,0	0,783	72,0	1,186	92,0	1,417	141,0	2,304	353,0	88,3	1,423
Citations in other citation indexes and databases (not listed above) (3.2,4.2,9,10)	0,0	0,000	0,0	0,000	0,0	0,000	0,0	0,000	0,0	0,0	0,000
Other citations (not listed above) (3, 4, 3.1, 4.1)	29,0	0,473	8,0	0,132	14,0	0,216	52,0	0,850	103,0	25,8	0,415
Reviews (5,6)		0,000		0,000		0,000		0,000	0,0		

2.2.2. List of 10 most-cited publications, with number of citations, in the assessment period (2011 – 2014).

1. NAGLER, Bob - SAKSL, Karel. Turning solid aluminium transparent by intense soft X-ray photoionization. In *Nature Physics*, 2009, vol. 5, p. 693-696. (16.821 - IF2008). **61 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. (2.699 - IF2011). **34 citations**

3. 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. (1.562 - IF2007). **34 citations**

4. 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. (1.416 - IF2009). **30 citations**

5. DUSZOVÁ, Annamária - DUSZA, Ján - TOMÁŠEK, K. - MORGIEL, Jerzy - BLUGAN, Gurdial - KUEBLER, Jakob. Zirconia/carbon nanofiber composite. In *Scripta Materialia*, 2008, vol. 58, p. 520-523. (2.481 - IF2007). **29 citations**

6. LOFAJ, František - SATET, R. - HOFFMANN, M.J. - ARELLANO-LÓPEZ, Antonio Ramírez de. Thermal expansion and glass transition temperature of the rare-earth doped oxynitride glasses. In *Journal of the European Ceramic Society*, 2004, vol. 24, p. 3377-3385. **28 citations**

7. ŠTULAJTEROVÁ, Radoslava - MEDVECKÝ, Ľubomír. Effect of calcium ions on transformation brushite to hydroxyapatite in aqueous solutions. In *Colloids and Surfaces A : Physicochem. Eng. Aspects*, 2008, vol. 316, p. 104-109. (1.601 - IF2007). **26 citations**

8. DUSZA, Ján - BLUGAN, Gurdial - MORGIEL, Jerzy - KUEBLER, Jakob - INAM, Fawad - PEIJS, Ton - REECE, Michael J. - PUCHÝ, Viktor. Hot pressed and spark plasma sintered zirconia/carbon nanofiber composites. In *Journal of the European Ceramic Society*, 2009, vol. 29, p. 3177-3184. (1.580 - IF2008). **25 citations**

9. VÝROSTKOVÁ, Anna - HOMOLOVÁ, Viera - PECHA, Jozef - SVOBODA, Milan. Phase evolution in P92 and E911 weld metals during ageing. In *Materials Science and Engineering*. A.Structural Materials, 2008, vol. 480, p. 289-298. (1.457 - IF2007). **24 citations**

10. 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. (2.353 - IF2011). **23 citations**

2.2.3. List of most-cited authors from the Institute (at most 10 % of the research employees with university degree engaged in research projects) and their number of citations in the assessment period (2011– 2014).

1) Ján Dusza – 392 citations
2) Pavol Hvizdoš – 177 citations
3) Karel Saksl – 168 citations

4) Eva Dudrová – 163 citations
5) Ľubomír Medvecký – 117 citations
6) František Kováč – 117 citations
7) František Lofaj – 110 citations

- **Supplementary information and/or comments on responses to the scientific output of the institute.**

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

- **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.

Program: 7RP

1)

Title of the project:	**Innovative materials solutions for Transport, Energy and Biomedical sectors by strengthening integration and enhancing research dynamics of KMM-VIN**
Slovak title:	Inovatívne materiálové riešenia pre oblasť dopravy, energie a biomedicíny pomocou posilnenia integrácie a zvýšenia dynamiky výskumu v KMM-VIN
Grant number:	290526
Acronym:	KMM-VIN
Type of project/ Program:	FP7
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza –** project manager (for Slovakia)
Co-organisation:	European Virtual Institute on Knowledge-based Multifunctional Materials, AISBL
Duration of the project:	1.2.2012 / 31.1.2015
Financial support:	
2012:	national support: 3600 €
2013:	national support: 4000 €
2014:	national support: 4000 €
2015:	EU: 14 748 €

2)

Title of the project:	**Immersion in the Science Worlds through the Arts**
Slovak title:	Ponorenie sa do sveta vedy prostredníctvom umenia
Grant number:	7RP- 26656
Acronym:	ISWA
Type of project/ Program:	FP7
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza –** project manager (for Slovakia)
Co-organisation:	UNIVPM
Duration of the project:	1.3.2011 / 28.2.2013
Financial support:	
2012:	EU: 8123 € + national support: 4000 €
2013:	EU: 3057 € + national support: 600 €

3)

Title of the project:	**Early recognition, monitoring and integrated management of emerging, new technology related risks**

Slovak title:	Včasné zistenie, monitorovanie a integrovaný manažment rizík prinášaných s novými technológiami
Grant number:	PP7RP-0133-08
Acronym:	INTEG-RISK
Type of project/ Program:	FP7
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza –** project manager (for Slovakia)
Co-organisation:	European Virtual Institute on Knowledge-based Multifunctional Materials, AISBL
Duration of the project:	1.11.2008 / 31.10.2012
Financial support:	
2012:	EÚ: 12922 €

4)

Title of the project:	**Macro, Micro and Nano Aspects of Machining**
Slovak title:	Makro, Mikro a nano aspekty obrábania
Grant number:	PP7RP-0030-07
Acronym:	MAMINA
Type of project/ Program:	FP7
Responsible person in the organisation and his/her status in the project:	**Dr. Karel Saksl –** project manager (for Slovakia)
Co-organisation:	Technische Universität Carolo Wilhelmina zu Braunschweig
Duration of the project:	1.11.2008 / 31.10.2012
Financial support:	
2012:	EU: 60008 € + national support: 7505 €
2013:	EU: 81837 €

Program: ERANET

5)

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:	
Acronym:	GRACE
Type of project/ Program:	M-ERA.NET
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza –** project manager (for Slovakia)
Co-organisation:	Dr. Andreas Kailer, Fraunhofer Institute for Mechanics of Materials IWM, Woehlerstr. 11, Freiburg, Germany
Duration of the project:	1.9.2014 / 31.8.2017
Financial support:	
2014:	M-ERA.NET: 5533 €
2015:	M-ERA.NET: 18500 €

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:	
Acronym:	ExploGuard

Type of project/ Program:	M-ERA.NET
Responsible person in the organisation and his/her status in the project:	**Dr. Karel Saksl –** project manager (for Slovakia)
Co-organisation:	University Research Centre – Functional Materials, Warsaw University of Technology
Duration of the project:	1.9.2014 / 31.8.2017
Financial support:	
2014:	M-ERA.NET: 8333 €
2015:	M-ERA.NET: 25000 €

7)

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:	ID #13-LightMat4Space, resp. 609556
Acronym:	RUS PLUS
Type of project/ Program:	M-ERA.NET
Responsible person in the organisation and his/her status in the project:	**Assoc. Prof. Dr. František Lofaj –** project manager (for Slovakia)
Co-organisation:	Lodz University of Technology, Poland
Duration of the project:	1.10.2015 / 30.9.2016
Financial support:	
2015:	M-ERA.NET: 0 €

Program: Multilateral

8)

Title of the project:	**High temperature properties of PM components for turbocharger applications**
Slovak title:	Vysokoteplotné vlastnosti PM komponentov pre turbodmýchadlá
Grant number:	Hoganas Chair V
Acronym:	HOGA
Type of project/ Program:	
Responsible person in the organisation and his/her status in the project:	**Assoc. Prof. Dr. Eva Dudrová –** project manager (for Slovakia)
Co-organisation:	Höganäs AB Švédsko
Duration of the project:	1.5.2011 / 30.4.2014
Financial support:	
2012:	Hoganäs AB: 33673 €
2013:	Hoganäs AB: 48226 €
2014:	Hoganäs AB: 16477 €

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

1. 2012 E-MRS FALL MEETING - Sympózium "Nanoceramics and Ceramic Based Nanocomposites", Varšava, 17.09.-21.09.2012

2. Fraktografia 2012 (Fractography 2012),KC Academia Stará Lesná, Vysoké Tatry, 21.10.-24.10.2012

3. The Functional Composites (Funkčné kompozity), KC Academia Stará Lesná, 23.10.-23.10.2012

4. Fractography of Advanced Ceramics, KC Smolenice, 29.09.-02.10.2013

5. Metalografia 2013 (Metallography 2013), KC Academia, Stará Lesná, 24.-26.4.2013

6. Funkčné kompozitné materiály (Functional Composite Materials), IMR SAS Košice, 17.05.2013

7. Funkčné kompozitné materiály (Functional Composite Materials), IMR SAS Košice, 29.04. 2014

8. Lokálne mechanické vlastnosti (Local Mechanical Properties, LMP 2014), KC Academia Stará Lesná, 12.11.-14.11.2014

9. Deformation and Fracture in Structural PM Materials –DF PM 2014, KC Academia, Stará Lesná, 26.10.-29.10.2014

10. Workshop Fractography of Sintered Steels - Principles and Application 2015 (Worshop FRACTO 2015), IMR SAS Košice, 23.03.-25.03.2015

11. Funkčné kompozitné materiály 2015 (Functional Composite Materials), IMR SAS Košice, 19.05.2015

12. Fraktografia 2015 (Fractography 2015), KC Academia Stará Lesná, 18.10.-21.10.2015

2.3.3. List of edited proceedings from international scientific conferences.

2.3.4. List of journals edited/published by the institute:

2.3.4.1. WOS (IF of journals in each year of the assessment period)

WOS: Kovové materiály ISSN 0023-432X
IF2011: 0,451
IF2012: 0,687
IF2013: 0,546
IF2014: 0,406

2.3.4.2. SCOPUS: Acta Metallurgica Slovaca ISSN 1335-1532

2.3.4.3. other databases

2.3.4.4. not included in databases Powder Metallurgy Progress ISSN 1335-8978

- **National position of the institute**

2.3.5. List of selected projects of national importance

1)

Title of the project:	**Infrastructure Improving of Centre of Excellence of Advanced Materials with Nano- and Submicron-Structure**
Slovak title:	Budovanie infraštruktúry Centra excelentnosti progresívnych materiálov s nano a submikrónovou štruktúrou
Grant number:	ITMS: 26220120035

Acronym:	NanoCexMat
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** - coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.5.2010 / 30.4.2013
Financial support:	2012 - ASFEU: 264188 € 2013 -ASFEU: 27138 €

2)

Title of the project:	**Centre of low temperature physics and material research at extreme conditions**
Slovak title:	Centrum fyziky nízkych teplôt a materiálového výskumu v extrémnych podmienkach
Acronym:	CFNT-MVEP
Type of project/Program:	CE
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Peter Samuely - coordinator** **Prof. Dr. Ján Dusza** - project manager
Co-organisation:	Institute of Experimental Physics SAS
Duration:	4.8.2011 / 31.12.2014 - 30.6.2015
Financial support:	2012 - SAS: 4750 € 2013 - SAS: 4750 € 2014 - SAS: 3500 € 2015 - SAS: 2100 €

3)

Title of the project:	**Research Centre of Advanced Materials and Technologies for Recent and Future Applications „PROMATECH“**
Slovak title:	Výskumné centrum progresívnych materiálov a technológií pre súčasné a budúce aplikácie „PROMATECH“
Grant number:	ITMS: 26220220186
Acronym:	PROMATECH
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** - project manager
Co-organisation:	Slovak Academy of Scince Bratislava, Slovakia
Duration:	30.8.2013 / 31.7.2015
Financial support:	2013 - ASFEU: 0 € 2014 - ASFEU: 26255 € 2015 - ASFEU: 421991 €

2.3.6. Projects of the Slovak Research and Development Agency (APVV)

1)

Title of the project:	**Microstructure and properties of powder micro and nano-composite materials for middle frequency aplications**
Slovak title:	Mikroštruktúra a vlastnosti mikro a nano-kompozitných materiálov pre stredofrekvenčné magnetické aplikácie
Grant number:	APVV-0222-10
Acronym:	MAGCOMP
Type of project/Program:	APVV
Responsible person in the organisation and his/her	**Assoc.Prof. Dr. Eva Dudrová –** coordinator

status in the project:
Co-organisation: Institute of Materials Research of SAS Košice, Slovakia
Duration: 1.5.2011 / 31.10.2014
Financial support: 2012 - APVV: 43287 €
2013 - APVV: 41687 €
2014 - APVV: 34287 €

2)

Title of the project: **Silicon oxynitride-based photoluminecent ceramic materials**
Slovak title: Fotoluminescenčné keramické materiály na báze oxynitridov kremíka
Grant number: APVV-14-0385
Acronym: LuminSion
Type of project/Program: APVV
Responsible person in the organisation and his/her status in the project: **Prof. Dr. Ján Dusza –** project manager
Co-organisation: Institute of Inorganic Chemistry of SAS Bratislava, Slovakia
Duration: 1.7.2015 / 30.6.2019
Financial support: 2015 - APVV: 6814 €

3)

Title of the project: **Application of progressive tool coatings for increasing the effectiveness and productivity of forming sheets made of modern materials**
Slovak title: Aplikácia progresívnych povlakov nástrojov pre zvýšenie efektívnosti a produktivity lisovania plechov z moderne koncipovaných materiálov
Grant number: APVV-0682-11
Acronym: APONAZEP
Type of project/Program: APVV
Responsible person in the organisation and his/her status in the project: **Dr. Miroslav Džupon –** project manager
Co-organisation: Technical University Košice, Slovakia
Duration: 1.7.2012 / 30.6.2015
Financial support: 2012 - APVV: 17709 €
2013 - APVV: 34674 €
2014 - APVV: 30938 €
2015 - APVV: 15381 €

4)

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
Acronym: ZKVAVESE
Type of project/Program: APVV
Responsible person in the organisation and his/her status in the project: **Dr. Miroslav Džupon –** project manager
Co-organisation: Technical University Košice, Slovakia
Duration: 1.7.2015 / 30.6.2018
Financial support: 2015 - APVV: 20198 €

5)

Title of the project:	**Development of SiC based conductive ceramics**
Slovak title:	Vývoj vodivej keramiky na báze SiC
Grant number:	APVV-0108-12
Acronym:	ConCer
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Pavol Hvizdoš –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.10.2013 / 30.9.2017
Financial support:	2013 - APVV: 7160 € 2014 - APVV: 28951 € 2015 - APVV: 31760 €

6)

Title of the project:	**Mechanisms of corrosion and micromechanical properties of dental materials**
Slovak title:	Mechanizmy korózie a mikromechanické vlastnosti dentálnych materiálov
Grant number:	APVV-0218-11
Acronym:	KoroDENT
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Monika Tatarková (Kašiarová) –** project manager
Co-organisation:	Institute of Inorganic Chemistry of SAS Bratislava, Slovakia
Duration:	1.7.2012 / 31.12.2015
Financial support:	2012 - APVV: 6198 € 2013 - APVV: 10080 € 2014 - APVV: 9377 € 2015 - APVV: 10308 €

7)

Title of the project:	**Development of Si3N4 with addition of graphene platelets**
Slovak title:	Vývoj nitridu kremičitého s prídavkom multivrstiev grafénu
Grant number:	APVV-0161-11
Acronym:	SINGRA
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Monika Tatarková (Kašiarová) –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.7.2012 / 31.12.2015
Financial support:	2012 - APVV: 25613 € 2013 - APVV: 44923 € 2014 - APVV: 37910 € 2015 - APVV: 46057 €

8)

Title of the project:	**Development of composite biomaterials based on silicon nitride**
Slovak title:	Vývoj kompozitných biomateriálov na báze nitridu kremičitého
Grant number:	APVV-0500-10
Acronym:	BioNitride
Type of project/Program:	APVV

Responsible person in the organisation and his/her status in the project:	**Dr. Monika Kašiarová –** project manager
Co-organisation:	Institute of Inorganic Chemistry of SAS Bratislava, Slovakia
Duration:	1.5.2011 / 31.10.2014
Financial support:	2012 - APVV: 10665 € 2013 - APVV: 10915 € 2014 - APVV: 10107 €

9)

Title of the project:	**High-strength electro-technical composite steels**
Slovak title:	Vysokopevné elektrotechnické kompozitné ocele
Grant number:	APVV-0147-11
Acronym:	HACOSTE
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. František Kováč –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.7.2012 / 31.12.2015
Financial support:	2012 - APVV: 28192 € 2013 - APVV: 49664 € 2014 - APVV: 41305 € 2015 - APVV: 56596 €

10)

Title of the project:	**Biodegradable metallic materials prepared by powder technologies**
Slovak title:	Biologicky odbúrateľné kovové materiály pripravené práškovými technológiami
Grant number:	APVV-0677-11
Acronym:	AMETIST
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Miriam Kupková –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.7.2012 / 31.12.2015
Financial support:	2012 - APVV: 26232 € 2013 - APVV: 33926 € 2014 - APVV: 31623 € 2015 - APVV: 34336 €

11)

Title of the project:	**High temperature oxidation resistant nanocomposite coatings with improved lifetime**
Slovak title:	Vysokoteplotné nanokompozitné povlaky so zvýšenou oxidačnou odolnosťou a životnostou
Grant number:	APVV-0520-10
Acronym:	HACONE
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Assoc. Prof. Dr. František Lofaj –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.5.2011 / 31.12.2013
Financial support:	2012 - APVV: 35976 € 2013 - APVV: 32017 €

12)

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
Acronym:	MICONA
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Assoc. Prof. Dr. František Lofaj –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.7.2015 / 29.6.2018
Financial support:	2015 - APVV: 30699 €

13)

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
Acronym:	SVE-Sn
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Karel Saksl –** project manager
Co-organisation:	Technical University Košice, Slovakia
Duration:	1.7.2015 / 30.6.2018
Financial support:	2015 - APVV: 9678 €

14)

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
Acronym:	Plazmon
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Assoc. Prof. Dr. František Lofaj –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.9.2015 / 31.12.2016
Financial support:	2015 - APVV: 91 €

15)

Title of the project:	**Study of welds and heat effected zones of bimetals**
Slovak title:	Štúdium zvarov a tepelne ovplyvnených zón bimetalov
Grant number:	SK-CZ-2013-0164
Acronym:	BIMETAL
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Karel Saksl –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.1.2015 / 31.12.2015

Financial support:	2015 - APVV: 1803 €

16)

Title of the project:	**Progresive soft magnetic materials base on multicomponent alloys**
Slovak title:	Progresívne magneticky mäkké materiály na báze viaczložkových zliatin
Grant number:	SK-CZ-2013-0150
Acronym:	PROMALLOY
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Magdaléna Strečková –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.1.2015 / 31.12.2015
Financial support:	2015 - APVV: 2652 €

17)

Title of the project:	**Study of the Processes of Coating and Formation of Nano-Structured Active Carbon at Processing of Low Alloyed Sintered Steel Components from Powder Mixtures**
Slovak title:	Štúdium procesov povlakovania a tvorby nano-štruktúrneho aktívneho uhlíka pri príprave nízkouhlíkových spekaných súčiastok z práškových zmesí
Grant number:	SK-BG-0032-10
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Marcela Selecká** – project manager Coordinator - Institute of Metal Science, Bulgarian Academy of Sciences, Sofia
Financial support:	2012 - APVV: 1549,20 €

18)

Title of the project:	**Investigation of mechanical and fracture behaviour of nanoceramic composites reinforced by boron nitride nanotubes**
Slovak title:	Štúdium mechanických a lomových vlastností nanokeramických kompozitov spevnených nanotrubičkami nitridu bóru
Grant number:	SK-CZ-2013-0194
Acronym:	KONANIB
Type of project/Program:	APVV
Responsible person in the organisation and his/her status in the project:	**Dr. Peter Tatarko –** coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.1.2015 / 31.12.2015
Financial support:	2015 - APVV: 1389 €

2.3.7. Projects of the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA)

1)

Title of the project:	**Effect of dispersion particles on structure formation and properties of nanocomposites prepared by SPD method**
Slovak title:	Vplyv disperzných častíc na formovanie štruktúry a vlastností nanokompozitov pripravených metódou SPD
Grant number:	2/0025/11
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Michal Besterci**
Duration:	1.1.2011 / 31.12.2013
Financial support:	2012 - SAS: 3761 € 2013 - SAS: 3665 €

2)

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:	**Prof. Dr. Michal Besterci**
Duration:	1.1.2014 / 31.12.2016
Financial support:	2014 - SAS: 6298 € 2015 - SAS: 6566 €

3)

Title of the project:	**Formation and degradation nanograin size structures**
Slovak title:	Formovanie a degradácia nanorozmerných štruktúr
Grant number:	1/0359/11
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Michal Besterci**
Duration:	1.1.2011 / 31.12.2013
Financial support:	2012 - SAS: - 2013 - SAS: 1366 €

4)

Title of the project:	**Evolution of the microstructure and phase transformation of sol-gel precursors in lead-free ferroelectric (K, Na)NbO3 thin films**
Slovak title:	Vývoj mikroštruktúry a fázová transformácia sol-gel prekurzorov bezolovnatých feroelektrických (K, Na)NbO3 tenkých filmov
Grant number:	2/0024/11
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Helena Bruncková**
Duration:	1.1.2011 / 31.12.2013
Financial support:	2012 - SAS: 5064 €

2013 - SAS: 4933 €

5)

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:	**Dr. Helena Bruncková**
Duration:	1.1.2014 / 31.12.2016
Financial support:	2014 - SAS: 3901 € 2015 - SAS: 4838 €

6)

Title of the project:	**Preparation, microstructure and properties of magnetic composites based on iron powders**
Slovak title:	Príprava, mikroštruktúra a vlastnosti magnetických kompozitov na báze práškového železa
Grant number:	2/0155/12
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Radovan Bureš**
Duration:	1.1.2012 / 31.12.2014
Financial support:	2012 - SAS: 8536 € 2013 - SAS: 9021 € 2014 - SAS: 6408 €

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:	2/0485/15
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Radovan Bureš**
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - SAS: 9331 €

8)

Title of the project:	**Interpretation and classification of the failure of sintered steels**
Slovak title:	Interpretovanie a klasifikovanie porušovania spekaných ocelí
Grant number:	2/0052/14
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Assoc. Prof. Dr. Eva Dudrová**
Duration:	1.1.2014 / 31.12.2015

Financial support:	2014 - SAS: 836 € 2015 - SAS: 864 €

9)

Title of the project:	**Structure stability of nanocrystalline metal materials prepared by progressive powder technology**
Slovak title:	Štruktúrna stabilita nanokryštalických kovových materiálov pripravených progresívnou práškovou technológiou
Grant number:	2/0167/10
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Juraj Ďurišin**
Duration:	1.1.2010 / 31.12.2012
Financial support:	2012 - SAS: 9044 €

10)

Title of the project:	**Study of microstructure and thermal stability of metallic glasses and nanocrystalline materials**
Slovak title:	Štúdium štruktúry a teplotnej stability kovových skiel a nanokryštalických materiálov.
Grant number:	2/0128/13
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Juraj Ďurišin**
Duration:	1.1.2013 / 31.12.2015
Financial support:	2013 - SAS: 14802 € 2014 - SAS: 13377 € 2015 - SAS: 15553 €

11)

Title of the project:	**Mechanical properties of tooth enamel and synthetic dental materials**
Slovak title:	Mechanické vlastnosti zubnej skloviny a syntetických zubných výplní
Grant number:	2/0122/12
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza**
Duration:	1.1.2012 / 31.12.2014
Financial support:	2012 - SAS: 5423 € 2013 - SAS: 6342 € 2014 - SAS: 4624 €

12)

Title of the project:	**Modification of the heat-affected zone microstructures of welded joints of advanced 9Cr ferritic creep-resistant steels with boron for the purpose of their creep-resistance and toughness improvement**
Slovak title:	Modifikácia štruktúr teplom-ovplyvnenej oblasti zvarových spojov moderných 9Cr feritických žiarupevných ocelí s bórom za účelom zlepšenia ich creepovej odolnosti a húževnatosti
Grant number:	2/0116/13
Type of project/Program:	VEGA

Responsible person in the organisation and his/her status in the project:	**Dr. Ladislav Falat**
Duration:	1.1.2013 / 31.12.2015
Financial support:	2013 - SAS: 6695 € 2014 - SAS: 5155 € 2015 - SAS: 5703 €

13)

Title of the project:	**Thermodynamic description of B-Cr and Fe-B-Cr systems**
Slovak title:	Termodynamický opis systémov B-Cr a Fe-B-Cr
Grant number:	2/0153/12
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Viera Homolová**
Duration:	1.1.2012 / 31.12.2014
Financial support:	2012 - SAS: 7163 € 2013 - SAS: 8740 € 2014 - SAS: 7758 €

14)

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:	**Dr. Viera Homolová**
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - SAS: 7776 €

15)

Title of the project:	**Tribological properties of ceramic nanostructured composites**
Slovak title:	Tribologické vlastnosti keramických nanoštruktúrnych kompozitov
Grant number:	2/0120/10
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Pavol Hvizdoš**
Duration:	1.1.2010 / 31.12.2012
Financial support:	2012 - SAS: 10190 €

16)

Title of the project:	**Local mechanical properties of bone cement**
Slovak title:	Lokálne mechanické vlastnosti kostného cementu
Grant number:	2/0075/13

Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Pavol Hvizdoš**
Duration:	1.1.2013 / 31.12.2015
Financial support:	2013 - SAS: 12036 € 2014 - SAS: 9054 € 2015 - SAS: 8636 €

17)

Title of the project:	**Research of the properties of composite coatings applied by advanced PVD technologies onto powder metallurgy tools**
Slovak title:	Výskum vlastností kompozitných povlakov aplikovaných modernými PVD technológiami na nástrojoch práškovej metalurgie
Grant number:	2/0060/11
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Dagmar Jakubéczyová**
Duration:	1.1.2011 / 31.12.2013
Financial support:	2012 - SAS: 4338 € 2013 - SAS: 3992 €

18)

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:	**Dr. Dagmar Jakubéczyová**
Duration:	1.1.2014 / 31.12.2016
Financial support:	2014 - SAS: 5711 € 2015 - SAS: 6911 €

19)

Title of the project:	**The study of the creep behaviour and thermal shock resistance of Si3N4-SiC composites with rare-earth oxide additives**
Slovak title:	Odolnosť proti tečeniu a tepelným šokom žiarovo-lisovaných Si3N4-SiC kompozitov s prídavkom oxidov vzácnych zemín
Grant number:	2/0156/10
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Monika Kašiarová**
Duration:	1.1.2010 / 31.12.2012
Financial support:	2012 - SAS: 6027 €

20)

Title of the project:	**Microstructure design of progressive isotropic electrotechnical steels**

Slovak title:	Mikroštruktúrny dizajn progresívnych izotrópnych elektrotechnických ocelí
Grant number:	2/0138/10
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. František Kováč**
Duration:	1.1.2010 / 31.12.2012
Financial support:	2012 - SAS: 10551 €

21)

Title of the project:	**High-strength electro-technical steels for electric vehicles and hybrid motors**
Slovak title:	Vysokopevné elektrotechnické ocele pre elektromobily a hybridné pohony
Grant number:	2/0083/13
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. František Kováč**
Duration:	1.1.2013 / 31.12.2015
Financial support:	2013 - SAS: 11630 € 2014 - SAS: 7525 € 2015 - SAS: 11406 €

22)

Title of the project:	**Multiferroics – fabrication, structure and properties of substitutionally modified bismuth ferrite based materials**
Slovak title:	Multiferoické materiály – príprava, štruktúra a vlastnosti substitučne modifikovaných perovskitových systémov na báze oxidu železito-bizmutitého
Grant number:	2/0053/11
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Vladimír Kovaľ**
Duration:	1.1.2011 / 31.12.2013
Financial support:	2012 - SAS: 2170 € 2013 - SAS: 2115 €

23)

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:	**Dr. Vladimír Kovaľ**
Duration:	1.1.2014 / 31.12.2016
Financial support:	2014 - SAS: 2786 € 2015 - SAS: 3455 €

24)

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:	**Dr. Alexandra Kovalčíková**
Duration:	1.1.2014 / 31.12.2016
Financial support:	2014 - SAS: 4179 € 2015 - SAS: 4837 €

25)

Title of the project:	**Metallic biomaterials prepared by powder-processing techniques**
Slovak title:	Kovové biomateriály pripravené práškovými technológiami
Grant number:	2/0168/12
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Miriam Kupková**
Duration:	1.1.2012 / 31.12.2014
Financial support:	2012 - SAS: 4822 € 2013 - SAS: 4699 € 2014 - SAS: 3437 €

26)

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:	**Dr. Miriam Kupková**
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - SAS: 6912 €

27)

Title of the project:	**Preparation and characterization of nanostructured functional layers**
Slovak title:	Príprava a charakterizácia nanoštruktúrovaných funkčných vrstiev
Grant number:	1/0211/12
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Miriam Kupková**
Duration:	1.1.2012 / 31.12.2015
Financial support:	2012 - SAS: 375 € 2013 - SAS: 3648 € 2014 - SAS: 2090 € 2015 - SAS: 2184 €

28)

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:	**Dr. Lenka Kvetková**
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - SAS: 7256 €

29)

Title of the project:	**The influence of the residual stresses in the nanocomposite Me-N and Me-C (Me = W, Cr, Ti, Al) coatings on their mechanical properties**
Slovak title:	Vplyv zvyškových napätí v Me-N a Me-C (Me = W, Cr, Ti, Al) povlakoch na ich mechanické vlastnosti
Grant number:	2/0108/11
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Assoc. Prof. Dr. František Lofaj**
Duration:	1.1.2011 / 31.12.2013
Financial support:	2012 - SAS: 14101 € 2013 - SAS: 17265 €

30)

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 in the project:	**Assoc. Prof. Dr. František Lofaj**
Duration:	1.1.2014 / 31.12.2016
Financial support:	2014 - SAS: 13094 € 2015 - SAS: 7944 €

31)

Title of the project:	**Composite biocement-biopolymer systems with addition of surfactants**
Slovak title:	Kompozitné systémy biocement-biopolymér s povrchovo aktívnymi aditívami
Grant number:	2/0026/11
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Ľubomír Medvecký**
Duration:	1.1.2011 / 31.12.2013
Financial support:	2012 - SAS: 4341 € 2013 - SAS: 6344 €

32)

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:	**Dr. Ľubomír Medvecký**
Duration:	1.1.2014 / 31.12.2016
Financial support:	2014 - SAS: 6688 € 2015 - SAS: 8295 €

33)

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:	**Dr. Ivan Petryshynets**
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - SAS: 5184 €

34)

Title of the project:	**Evaluation of strain and fracture properties of dual-phase steels on miniature samples**
Slovak title:	Hodnotenie deformačných a lomových vlastností dvojfázových ocelí prostredníctvom miniatúrnych vzoriek
Grant number:	2/0192/12
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Assoc. Prof. Dr. Gejza Rosenberg**
Duration:	1.1.2012 / 31.12.2014
Financial support:	2012 - SAS: 7234 € 2013 - SAS: 4933 € 2014 - SAS: 3901 €

35)

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:	**Assoc. Prof. Dr. Gejza Rosenberg**
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - SAS: 4896 €

36)

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:	**Dr. Monika Tatarková (Kašiarová)**
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - SAS: 6911 €

37)

Title of the project:	**Degradation and filure of dissimilar weld joints P92/312H with Ni-based filler metal**
Slovak title:	Degradácia a porušovanie heterogénnych zvarových spojov P92/316H s prídavným materiálom na báze Ni
Grant number:	2/0128/10
Type of project/Program:	VEGA
Responsible person in the organisation and his/her status in the project:	**Dr. Anna Výrostková**
Duration:	1.1.2010 / 31.12.2012
Financial support:	2012 - SAS: 5547 €

2.3.8. Projects of SAS Centres of Excellence

1)

Title of the project:	**Centre of low temperature physics and material research at extreme conditions**
Slovak title:	Centrum fyziky nízkych teplôt a materiálového výskumu v extrémnych podmienkach
Acronym:	CFNT-MVEP
Type of project/Program:	CE
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Peter Samuely - coordinator** **Prof. Dr. Ján Dusza** - project manager
Co-organisation:	Institute of Experimental Physics SAS
Duration:	4.8.2011 / 31.12.2014 - 30.6.2015
Financial support:	2012 - SAS: 4750 € 2013 - SAS: 4750 € 2014 - SAS: 3500 € 2015 - SAS: 2100 €

2.3.9. National projects supported by EU Structural Funds

1)

Title of the project:	**Advanced technology of preparation of micro-composite materials for electrotechnics**
Slovak title:	Progresívna technológia prípravy mikrokompozitných materiálov pre elektrotechniku
Grant number:	ITMS: 26220220105
Acronym:	MIKROMATEL
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Dr. Radovan Bureš** - coordinator

Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.12.2010 - 30.9.2013 - 31.3..2015
Financial support:	2012 - ASFEU: 111876 € 2013 - ASFEU: 32596 € 2014 - ASFEU: 214304 € 2015 - ASFEU: 30404 €

2)

Title of the project:	**New Materials and Technology for energetics**
Slovak title:	Nové materiály a technológie pre energetiku
Grant number:	ITMS 26220220061
Acronym:	TRAFOTRANS
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Dr. František Kováč** - project manager
Co-organisation:	Institute of Experimental Physic of SAS Košice, Slovakia
Duration:	1.9.2010 / 31.8.2013
Financial support:	2012 - ASFEU: 67533 € 2013 - ASFEU: 203639 € 2014 - ASFEU: 11178 €

3)

Title of the project:	**Infrastructure Improving of Centre of Excellence of Advanced Materials with Nano- and Submicron-Structure**
Slovak title:	Budovanie infraštruktúry Centra excelentnosti progresívnych materiálov s nano a submikrónovou štruktúrou
Grant number:	ITMS: 26220120035
Acronym:	NanoCexMat
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** - coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.5.2010 / 30.4.2013
Financial support:	2012 - ASFEU: 264188 € 2013 -ASFEU: 27138 €

4)

Title of the project:	**Centre of Excellence of Cearmics, Glasses and Silicates**
Slovak title:	Centrum excelentnosti pre keramiku, sklo a silikátové materiály
Grant number:	ITMS 26220120056
Acronym:	CEKSIM
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** - project manager
Co-organisation:	Institute of Inorganic Chemistry SAS, Bratislava, Slovakia
Duration:	1.9.2010 / 31.8.2013
Financial support:	2012 - ASFEU: 5365 € 2013 - ASFEU: 218395 € 2014 - ASFEU: 6083 €

5)

Title of the project:	**Slovak Research-Innovation Platform on Sustainable Mineral Resources**

Slovak title:	Slovenská výskumno-inovačná platforma pre trvalo udržateľné surovinové zdroje
Grant number:	ITMS: 26220220053
Acronym:	SVIP
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** - project manager
Co-organisation:	Technical University Košice, Slovakia
Duration:	1.1.2010 / 30.6.2013
Financial support:	2012 - ASFEU: 14633 € 2013 - ASFEU: 2889 € 2014 - ASFEU: 7696 €

6)

Title of the project:	**Research Centre of Advanced Materials and Technologies for Recent and Future Applications „PROMATECH“**
Slovak title:	Výskumné centrum progresívnych materiálov a technológií pre súčasné a budúce aplikácie „PROMATECH“
Grant number:	ITMS: 26220220186
Acronym:	PROMATECH
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** - project manager
Co-organisation:	Slovak Academy of Scince Bratislava, Slovakia
Duration:	30.8.2013 / 31.7.2015
Financial support:	2013 - ASFEU: 0 € 2014 - ASFEU: 26255 € 2015 - ASFEU: 421991 €

7)

Title of the project:	**Research Centrum for Combinated and Renewable Resources of Energy**
Slovak title:	Centrum výskumu účinnosti integrácie kombinovaných systeémov obnoviteľných zdrojov energií
Grant number:	ITMS 26220220064
Acronym:	VUKONZE
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Dr. František Kováč** - project manager
Co-organisation:	Technical University Košice, Slovakia
Duration:	1.6.2010 / 31.12.2013
Financial support:	2012 - ASFEU: 16168 € 2013 - ASFEU: 11552 € 2014 - ASFEU: 12231 €

8)

Title of the project:	**Technology of preparation of electrotechnical steels possessing high permeability for high affectivity electromotors**
Slovak title:	Technológia prípravy elektrotechnických ocelí s vysokou permeabilitou určených pre elektromotory s vyššou účinnosťou

Grant number:	ITMS 26220220037
Acronym:	DYNTRANS
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Dr. František Kováč** - coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.1.2010 / 30.6.2012
Financial support:	2012 - ASFEU: 9479 € 2013 - ASFEU: 10024 €

9)

Title of the project:	**Center of excellence of biomedical technologies**
Slovak title:	Centrum excelentnosti biomedicínskych technológií
Grant number:	ITMS 26220120066
Acronym:	CEXBIO
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Dr. Ľubomír Medvecký** - project manager
Co-organisation:	Pavol Jozef Šafárik University in Košice, Slovakia
Duration:	15.11.2010 / 31.10.2013
Financial support:	2012 - ASFEU: 51994 € 2013 - ASFEU: 18431 €

10)

Title of the project:	**Advanced implants seeded with stem cells for hard tissue regeneration and reconstruction**
Slovak title:	Pokročilé implantáty s naočkovanými kmeňovými bunkami na regeneráciu a rekonštrukciu tvrdých tkanív
Grant number:	ITMS 26220220032
Acronym:	IMSTEM
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Dr. Ľubomír Medvecký** - coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.1.2010 / 31.3.2012
Financial support:	2012 - ASFEU: 61797 €

11)

Title of the project:	**Improvement of utilization of sophisticated equipment and methods in research and education at IMR SAS**
Slovak title:	Zvýšenie kvality využívania sofistikovaných zariadení a metód vo výskume a výučbe na ÚMV SAV
Grant number:	ITMS 261102301054
Acronym:	VZDELAVANIE
Type of project/Program:	SF
Responsible person in the organisation and his/her status in the project:	**Dr. Anna Výrostková** - coordinator
Co-organisation:	Institute of Materials Research of SAS Košice, Slovakia
Duration:	1.1.2012 / 31.12.2012
Financial support:	2012 - ASFEU: 310896 € 2013 - ASFEU: 31588 €

2.3.10. List of journals (published only in the Slovak language) edited/published by the institute:

2.3.10.1. WOS (IF of journals in each year of the assessment period)

2.3.10.2. SCOPUS

2.3.10.3. Other databases

2.3.10.4. Not included in databases

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

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

2012

DUSZA, Ján. Failure and damage mechanisms in ceramic nanocomposites. In *Ceramic Transactions*, 2012, vol. 230, p. 133-148.

GALUSKOVÁ, Dagmar - KAŠIAROVÁ, Monika - HNATKO, Miroslav - GALUSEK, Dušan - ŠAJGALÍK, Pavol - DUSZA, Ján. Influence of corrosion on the surface characteristics and mechanical properties of structural ceramics. In *PASNPG. Potential and applications of surface nanotreatment of polymers and glass, october 15-17, 2012 : book of extended abstracts*. Eds. Vratislav Kapička, Vít Kudrle, Pavel Souček, Dana Skácelová, Jaroslav Hnilica, Petr Zeman, Pavel Baroch, Petra Prokopčáková, Adam Pazourek. - Brno, Czech Republic: Masarykova universita, 2012, p. 9-10. ISBN 978-80-210-5979-5.

DUSZA, Ján.: Sviatok Maďarskej vedy – Nanoceramics reinforced with particles and fibers, MAB MTA, MISKOLC, 2012.11.7

DUSZA, Ján: Fractography 2012 - Toughening mechanisms in ceramic-carbon nano-filler composites. 21.-24.10.2012, KC Academia, Stará Lesná

Invited lectures at important scientific institutions

BUREŠ, Radovan. Magnetically soft composites prepared by PM. Invited lecture at ÚMCH AVČR, Praha, ČR, 1.8.2012

DUSZA, Ján: IMIN – PAN Cracow, NANOCERAMICS – ANALYSES AND TESTING, October 26. 2011

2013

DUSZA, Ján. Silicon nitride + graphene platelet nanocomposites. In NANOVED 2013 & NANO INFO DAY : 6th International Conference on Nanosciences, Nanotechnologies, Nanomaterials and NANO INFO DAY of the Nanoforce Project. Svit, 22.-25.9.2013. - Brno : TRIBUN EU, 2013, p. O-18. ISBN 978-80-263-0511-8.

Invited lectures at important scientific institutions

E. Dudrová: „IMR-Capabilities in PM“ invited lecture, Seminar Höganäs Chair and Dpt. R&D Höganäs AB, Höganäs AB Sweden, 23.10.2013

2014

DUSZA, Ján. Nano-indentation and micropillar testing of WC grains in WC-Co. In Deformation and fracture in PM materials DFPM 2014 : International conference. Book of abstracts. Stará Lesná, 26.-29.10.2014. - Košice : Institute of Materials Research SAS, 2014, p. 23. ISBN 978-80-970964-8-9.

DUSZA, Ján. International Symposium on Novel and Nano Materials (ISNNM), Krakow, Poland, June 29 ~ July 4, 2014

DUSZA, Ján. Nano-indentation and micropillar testing of WC grains in WC - Co hardmetal International Conference, NANO 2014, Moscow, July 13 – 18, 2014, Ceramic + carbon based filler nanocomposites

DUSZA, Ján. CMME 2014, TÁLE – Nízke Tatry, Slovakia, 06th – 10th July, 2014 Nanoindentation testing of WC grains in WC – Co hardmetal

Invited lectures at important scientific institutions

HVIZDOŠ, Pavol. Invited lecture at seminar of the International Society Steel Strips „Basic and applied research at IMR SAS Košice aimed at material topics“, Herľany, october 2014,

HVIZDOŠ, Pavol. Invited lecture „Anisotropy of local mechanical properties of WC-Co composites“, at the Institute of Macromolecular Chemistry AV ČR, v.v.i., Praha, Czech Republic, july 2014.

HVIZDOŠ, Pavol. Invited lecture „Introduction of IMR SAS activities“, seminar Fine Ceramic Day, ELTE, Budapest, Hungary, december 2014

BUREŠ, Radovan. Advanced Metallic Materials and Composites – Institute of Materials Science Vietnam Academy of Science and Technology, Hanoi, Vietnam 22.5.2014

2015

SAKSL, Karel - OSTROUSHKO, Dmytro - MAZANCOVÁ, Eva - SZULC, Zygmunt - MILKOVIČ, Ondrej - ĎURIŠIN, Martin - BALGA, Dušan - ĎURIŠIN, Juraj. Structure of bimetals investigated by synchrotron radiation. In Metal 2015 : 24th international conference on metallurgy and materials. Proceedings of abstracts. Brno, 3.-5.6.2015. - Ostrava : Tanger Ltd., 2015. ISBN 978-80-87294-58-1

LUPTÁKOVÁ, Natália - BALLÓKOVÁ, Beáta - DYMÁČEK, Petr. Compressive creep testing of MoSi2-SiC nanocomposites. In Materiály a technologie ve výrobě speciální techniky : Sborník 13. odborného semináře. Brno, 20.5.2015 [elektronický zdroj]. - B.V., 2015, p. 89-92. ISBN 978-80-7231-999-2. CD

DUDROVÁ, Eva - KABÁTOVÁ, Margita. Fractography of sintered steels. In Proceedings of the workshop Fractography of sintered materials : Principles and application. Košice, 23.-25.3.2015. Ed. M. Hrubovčáková, E. Dudrová, M. Kabátová. - Košice : IMR SAS, 2015, p. 227-276. ISBN 978-80-89782-00-0.

FALAT, Ladislav. Fractography of steels loaded at elevated temperature. In Proceedings of the workshop Fractography of sintered materials : Principles and application. Košice, 23.-25.3.2015. Ed. M. Hrubovčáková, E. Dudrová, M. Kabátová. - Košice : IMR SAS, 2015, p. 215-226. ISBN 978-80-89782-00-0.

DUSZA, Ján. Fractography of advanced ceramics. In Proceedings of the workshop Fractography of sintered materials : Principles and application. Košice, 23.-25.3.2015. Ed. M. Hrubovčáková, E. Dudrová, M. Kabátová. - Košice : IMR SAS, 2015, p. 159-186. ISBN 978-80-89782-00-0.

WRONSKI, Andrew S. - KABÁTOVÁ, Margita - DUDROVÁ, Eva. Fracture micromechanics of some sintered steels. In Proceedings of the workshop Fractography of sintered materials: Principles and application. Košice, 23.-25.3.2015. Ed. M. Hrubovčáková, E. Dudrová, M. Kabátová. - Košice : IMR SAS, 2015, p. 53-70. ISBN 978-80-89782-00-0.

DUSZA, Ján. Ceramic matrix nanocomposites with carbon based fillers. In Euromat 2015 : European congress and exhibition on advanced materials and processes. Warsaw, 20.-24.9.2015 [elektronický zdroj]. - B.V., 2015. Názov z USB. USB.

HVIZDOŠ, Pavol - BALKO, Ján - KOVALČÍKOVÁ, Alexandra - FIDES, Martin. Tribological properties of silicon nitride based composites with graphene and boron nitride nanoparticles. In The first Polish-Korean joint workshop on advanced ceramics : Abstracts. Zakopane, 19.9.2015. Ed. L. Jaworska et al. - Kraków : Polskie Towarzystwo Ceramiczne, 2015, p. 28. ISBN 978-83-63663-64-3.

DUSZA, Ján. Micro-mechanical testing of WC, Si3N4 and ZrB2 ceramics: nanoindentation and micropillar testing. In The first Polish-Korean joint workshop on advanced ceramics : Abstracts. Zakopane, 19.9.2015. Ed. L. Jaworska et al. - Kraków : Polskie Towarzystwo Ceramiczne, 2015. ISBN 978-83-63663-64-3.

ŠAJGALÍK, Pavol - HNATKO, Miroslav - LENČÉŠ, Zoltán - GALL, Marián - DUSZA, Ján - TATARKO, Peter - CHLUP, Zdeněk. GB chemistry of silicon nitride based nano-composites - implications to mechanical, tribological and chemical properties. In ICACC 2015. 39th international conference and exposition on advanced ceramics and composites, Daytona Beach, Florida, USA, january 25-30, 2015 : abstract book. - USA : The American Ceramic Society, 2015, p. 67.

ŠAJGALÍK, Pavol - SEDLÁČEK, Jaroslav - LENČÉŠ, Zoltán - DUSZA, Ján - LIN, Hua-Tay. Additive-free hot-pressed silicon carbide ceramics - a material with exceptional mechanical properties. In ICACC 2015. 39th international conference and exposition on advanced ceramics and composites, Daytona Beach, Florida, USA, january 25-30, 2015 : abstract book. - USA : The American Ceramic Society, 2015, p. 113.

ŠAJGALÍK, Pavol - HNATKO, Miroslav - LENČÉŠ, Zoltán - GALL, Marián - DUSZA, Ján - TATARKO, Peter - CHLUP, Zdeněk. Chemistry composition of GB in Si3N4 - simulation and experiment. In International workshop on Sintering and microstructural evolution in ceramics, KAIST, Daejeon, Korea, august 27-29, 2015 : abstracts. - Korea : KAIST, 2015, p. 29.

ŠAJGALÍK, Pavol - SEDLÁČEK, Jaroslav - LENČÉŠ, Zoltán - DUSZA, Ján - LIN, Hua-Tay. Additive-free hot-pressed silicon carbide ceramics - a material with exceptional mechanical properties. In ACTSEA 2015. 5th international symposium on advanced ceramics and technology for sustainable energy applications, Tainan, Taiwan, 8-11 november 2015. - Taiwan, 2015, p. 67-68.

BALLÓKOVÁ, Beáta - BESTERCI, Michal - SÜLLEIOVÁ, Katarína - BALOG, Miroslav - HUANG, Song-Jeng. Effects of ECAP on the mechanical properties of Mg-Al2O3 nanocomposites. In AMME´2015 : 22nd winter international scientific conference on achievements in mechanical and materials engineering Winter-AMME´15. Gliwice - Zakopane, 6.-9.12.2015. Ed. L.A. Dobrzanski. - Gliwice, 2015, p. 43. ISBN 978-83-63553-39-5.

BESTERCI, Michal - SÜLLEIOVÁ, Katarína - BALLÓKOVÁ, Beáta - VELGOSOVÁ, Oksana. Models of damage mechanism of glidcop Cu-Al2O3 micro and nanomaterials. In AMME´2015 : 22nd winter international scientific conference on achievements in mechanical and materials engineering Winter-AMME´15. Gliwice - Zakopane, 6.-9.12.2015. Ed. L.A. Dobrzanski. - Gliwice, 2015, p. 44-45. ISBN 978-83-63553-39-5.

SAKSL, Karel. Príprava práškových materiálov z biodegradovateľných zliatin. In Funkčné kompozitné materiály : Konferencia s medzinárodnou účasťou. Zborník abstraktov. Košice, 19.5.2015. - Košice : Ústav materiálového výskumu SAV, 2015, s. 2. ISBN 978-80-89782-02-04.

HVIZDOŠ, Pavol. Pokročilé metódy hodnotenia lokálnych vlastností kompozitov. In Funkčné kompozitné materiály : Konferencia s medzinárodnou účasťou. Zborník abstraktov. Košice, 29.4.2014. - Košice : Ústav materiálového výskumu SAV, 2014, s. 14. ISBN 978-80-970964-7-2.

CSANÁDI, Tamás - CHINH, Nguyen Quang - SZOMMER, Péter - DUSZA, Ján - LENČÉŠ, Zoltán - ŠAJGALÍK, Pavol - GRASSO, Salvatore - REECE, Michael J. Nano and micromechanical testing of advanced ceramics. In Advanced research workshop Engineering Ceramics 2015, materials for better life, Smolenice castle, may 10-14, 2015 : book of abstracts. Eds. Zoltán Lenčéš, Jana Valúchová. - Bratislava, Slovakia : Institute of Inorganic Chemistry SAS, 2015, p. 61. ISBN 978-80-971648-3-6.

KABÁTOVÁ, Margita - DUDROVÁ, Eva. Static and fatigue crack nucleation, coalescence and growth to failure in sintered steels. In Fraktografia - Fractography 2015 : International conference. Book of abstracts. Stará Lesná, 18.-21.10.2015. Ed. B. Ballóková, K. Ondrejová. - Košice : Institute of Materials Research SAS, 2015.

DUSZA, Ján. Deformation and fracture of advanced ceramics at nano and micro level. In Fraktografia - Fractography 2015 : International conference. Book of abstracts. Stará Lesná, 18.-21.10.2015. Ed. B. Ballóková, K. Ondrejová. - Košice : Institute of Materials Research SAS, 2015.

Invited lectures at important scientific institutions

DUSZA, J. Invited lecture at ACMiN, AGH, Krakow, Poland „Introduction the PROMATECH - Research Centre“, Kakow, 22.1.2015

DUSZA, J. Invited lectures at North-Western Polytechnical University, Xian, China, december 2015:
DUSZA, J. Research Centre PROMATECH for Advanced Materials and Technologies
DUSZA, J. Ceramic-Carbon Based Filler Composites
DUSZA, J. Nano-mechanical Testing of Advanced Ceramics
DUSZA, J. Fractography of Advanced Ceramics

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

2012

Fraktografia 2012 (Fractography 2012), KC Academia Stará Lesná, Slovakia, 21.-24.10.2012

Prof. Dr. Ján Dusza	Chairman of the Programme Committee
Dr. Pavol Hvizdoš	Chairman of the Organizing Committee, Programme Committee member
Dr. Beáta Ballóková	Secretary of the Conference
Assoc. Prof. Dr. Eva Dudrová	Programme Committee member
Prof. Dr. Michal Besterci	Programme Committee member
Dr. Radovan Bureš	Programme Committee member
Dr. Dagmar Jakubéczyová	Committee member
Mgr. Katarína Ondrejová	Committee member
Dr. Marcela Selecká	Committee member
Jana Torkošová	Committee member

2012 E-MRS Fall Meeting - Symposium" Nanoceramics and Ceramic Based Nanocomposites", 17.-21.9.2012, Varšava, Poland

Prof. Dr. Ján Dusza	Conference Guarantee

Instrumentd Indentation Workshop IIW5, 21.-29.1.2012, Daytona Beach, USA

Assoc. Prof. Dr. František Lofaj	Committee member

Local Mechanical Properties 2012 ,7.-9.11.2012, Levoča, Slovakia

Assoc. Prof. Dr. František Lofaj	Programme Committee member

10th International Symposium of Croatian Metallurgical Society "Materials and Metallurgy" SHMD ´2012,17.-21.6.2012, Šibeník, Croatia

Dr. Peter Ševc	Scientific Committee member

NDT Days 2012 , 11.-15.7.2012, Sozopol, Bulgaria

Dr. Marcela Selecká	Scientific Committee member

2013

Funkčné kompozitné materiály (Functional Composite Materials), IMR SAS Košice, 17.05.2013

Dr. Radovan Bureš	Chairman of the Organizing Committee
Ing. Mária Fáberová	Committee member
Dr. Magdaléna Strečková	Programme Committee member

Fractography of Advanced Ceramics, KC Smolenice, Slovakia, 29.9.-2.10.2013

Prof. Dr. Ján Dusza	Co-Chairman of the Conference
Dr. Alexandra Kovalčíková	Secretary of the Conference
Dr.Monika Kašiarová	Committee member
Dr. Lenka Kvetková	Committee member
Dr. Pavol Hvizdoš	Committee member
Assoc. Prof. Dr. František Lofaj	Committee member
Ing. Ján Balko	Committee member
Ing. Marek Bľanda	Committee member

International Conference TEAM, 4.-6.11.2013, Prešov, Slovakia

Dr. Pavol Hvizdoš	Programme Committee member

Lokálne mechanické vlastnosti 2013 „LMV 2013“ (Local Mechanical Properties), Kutná Hora, Czech Republic, 6.-8.11.2013

Assoc. Prof. Dr. František Lofaj	Committee member

BALTRIP 2013, 10.-20.9.2013, Riga, Estónsko

Prof. Dr. Michal Besterci	Committee member

International Congress on Engineering and Technology, 25.-27.06.2013, Dubrovník, Croatia

Dr. Dagmar Jakubéczyová	Programme Committee member

2nd Congress of Biomedicine in Oro Maxilofacial Area, 11.-.15.9.2013, Košice, Slovakia

Dr. Ľubomír Medvecký	Programme Committee member

Winter School of Synchrotron Radiation 2013, 11.-.15.3.2013, Liptovský Ján, Slovakia

Dr. Karel Saksl	Programme Committee member

15th International Symposium on Metallography METALLOGRAPHY’2013, 24. – 26.4.2013, KC Academia, Stará Lesná, High Tatra Mountains, Slovakia

Dr. Peter Ševc	Scientific Committee member
	Honorary Committee
Prof. Dr. Ján Dusza	Scientific Committee member

2014

Funkčné kompozitné materiály (Functional Composite Materials), IMR SAS Košice, 29.04.2014

Dr. Radovan Bureš	Chairman of the Organizing Committee
Ing. Mária Fáberová	Committee member

Dr. Magdaléna Strečková	Programme Committee member

„**Deformation and Fracture in Structural PM Materials - DF PM 2014**“, KC Academia, Stará Lesná, Slovakia, 26.-29.10.2014

Assoc. Prof. Dr. Eva Dudrová	Co-Chairman of the Conference
Prof. Dr. Ján Dusza	Programme Committee member
Dr. Marcela Selecká	Chairman of Conference Organizing Committee
Dr. Beáta Balloková	Secretary of the Conference
Dr. Pavol Hvizdoš	Committee member
Ing. Margita Kabátová	Committee member
Dr. Dagmar Jakubéczyová	Committee member
Mgr. Katarína Ondrejová	Committee member
Jana Torkošová	Committee member

Lokálne mechanické vlastnosti 2014 „LMV 2014“ (Local Mechanical Properties), KC Stará Lesná, Slovakia, 12.-14.11.2014

Assoc. Prof. Dr. František Lofaj	Chairs of the Conference - Organizing Committee
Dr. Alexandra Kovalčíková	Committee member
Dr. Pavol Hvizdoš	Committee member
Dr. Lenka Kvetková	Committee member
Ing. Petra Hviščová	Committee member

ICMEM - International Conference of Manufacturing Engineering and Materials, 1.-.5.9.2014, Nový Smokovec, Slovakia

Dr. Pavol Hvizdoš	Programme Committee member

Winter School of Synchrotron Radiation 2014, 11.-.15.3.2014, Liptovský Ján, Slovakia

Dr. Karel Saksl	Committee member

2015

Funkčné kompozitné materiály (Functional Composite Materials), IMR SAS Košice, 19.05.2015

Dr. Radovan Bureš	Chairman of the Organizing Committee
Ing. Mária Fáberová	Committee member
Dr. Magdaléna Strečková	Programme Committee member

Workshop - Fractography of Sintered Materials 2015, IMR SAS Košice, Slovakia, 23.-25.03.2015

Assoc. Prof. Dr. Eva Dudrová	expert guarantor
Dr. Beáta Balloková	Committee member
Dr. Monika Hrubovčáková	Committee member
Ing. Margita Kabátová	Committee member
Dr. Ján Kepič	Committee member
Ing. Karol Kovaľ	Committee member
Ing. Róbert Džunda	Committee member
Mgr. Katarína Ondrejová	Committee member
Jana Torkošová	Committee member
Terézia Rácová	Committee member

Fraktografia 2015 (Fractography 2015), KC Academia Stará Lesná, Slovakia, 18.-21.10.2015

Prof. Dr. Ján Dusza	Chairman of the Programme Committee
Dr. Pavol Hvizdoš	Chairman of the Organizing Committee, Programme Committee member

Dr. Beáta Ballóková	Secretary of the Conference
Assoc. Prof. Dr. Eva Dudrová	Programme Committee member
Dr. Dagmar Jakubéczyová	Committee member
Mgr. Katarína Ondrejová	Committee member
Jana Torkošová	Committee member

14th European Ceramic Society Meeting - Symposium Structural Ceramics", 21.-25.6.2015, Toledo, Spain

Prof. Dr. Ján Dusza	Committee member

Euro PM 2015, Reims, France, 4.-7.10 2015

Assoc. Prof. Dr. Eva Dudrová	Programme Committee member

Instrumentd Indentation Workshop IIW5, 1.-5.11.2015, Dallas, Texas, USA

Assoc. Prof. Dr. František Lofaj	Committee member

Lokálne mechanické vlastnosti 2015 „LMV 2015“ (Local Mechanical Properties), Liberec, Czech Republic, 4.-6.11.2015

Assoc. Prof. Dr. František Lofaj	Programme Committee member

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

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

2014

HVIZDOŠ, Pavol. Invited lecture at domestic conference with international attendance “Functional composite materials”, IMR SAS Košice, Slovakia, april 2014

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

2012

Workshop - Progress in Advanced Ceramic Materials (Progresívne keramické materiály), Košická Belá - Ružín, Slovakia, 27.-28.11.2012

Prof. Dr. Ján Dusza	Conference Guarantee
Dr. Alexandra Kovalčíková	Committee member
	Programme Committee member

2014

Trans Tech Burza, Hotel Saffron Bratislava, Slovakia, 11.-12.11.2014

Prof. Dr. Ján Dusza	Chairman of the Organizing and Program Committee
Dr. Františka Dorčáková	Programme Committee member
Dr. Ján Kepič	Programme Committee member

2015

Trans Tech Burza, Hotel Saffron Bratislava, Slovakia, 29.-30.9.2015

Prof. Dr. Ján Dusza	Committee member
Dr. Františka Dorčáková	Committee member
Dr. Ján Kepič	Committee member

Workshop - Výskumné centrum progresívnych materiálov pre súčasné a budúce aplikácie "PROMATECH", (Research centre of advanced materials and technologies for recent and future applications), IMR SAS Košice, Slovakia, 26.2.2015

Prof. Dr. Ján Dusza	Honorary Committee
Dr. Pavol Hvizdoš	Honorary Committee
Dr. Františka Dorčáková	Committee member
Dr. Erika Múdra	Committee member

Brokerský deň Výskumného centra progresívnych materiálov a technológií "PROMATECH", (Broker day - Research centre of advanced materials and technologies for recent and future applications), IMR SAS Košice, Slovakia, 7.12.2015

Prof. Dr. Ján Dusza	Committee member
Dr. Františka Dorčáková	Committee member
Dr. Ján Kepič	Committee member

The 2nd International Conference on Nanomaterials: Fundamentals and Applications, NFA , UPJŠ Košice, Slovakia, 26.-28.10.2015

Dr. Miriam Kupková	Committee member
Dr. Monika Hrubovčáková	Committee member

Workshop - Progress in Advanced Ceramic Materials (Progresívne keramické materiály), Košická Belá - Ružín, Slovakia, 25.-27.11.2015

Assoc. Prof. Dr. František Lofaj	Committee member
Dr. Alexandra Kovalčíková	Committee member
Dr. Petra Hviščová	Committee member

- **Supplementary information and/or comments documenting the international and national status of the Institute**

2.4. Tables of project structure, research grants and other funding resources

- **International projects and funding**

2.4.1. Major projects within the European Research Area and other important project – Framework Programmes of the EU, ERA-NET, European Science Foundation, NATO, COST, INTAS, etc. (here and in items below please specify: 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"),

	Project title	Typ / Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute / Responsible person
2012	Innovative materials solutions for Transport, Energy and Biomedical sectors by strenghtening integration and enhancing research dynamics of KMM-VIN (INNVIN)	FP7-NMP-2011-CSA-5/290526	02/2012-01/2015	26348 (14748+11600)	I
	Macro, Micro and Nano Aspects of Machining - MAMINA	FP7-PEOPLE-2007-1-1-ITN/211536	09/2008-8/2012	149350 (141845+7505)	W
	Immersion in the Science Worlds through Arts - ISWA	FP7-SCIENCE-IN-SOCIETY-2010-1-CSA/266656	03/2011-02/2013	15780 (11180+4600)	I
	Early recognition, monitoring and integrated management of emerging, new technology related risk - INTEG-RISK	FP7-PP7RP-0133-08	11/2008-10/2012	12922	W
	High temperature properties of PM components for turbocharger applications	Höganäs Chair V	2/2011-4/2014	98376	W
2013					
2014	Graphene-ceramic composites for tribological application in aqueous environments	M-ERA.NET GRACE	9/2014-8/2017	24033	W
	Novel explosive welved corrosion resistant clad materials for geothermal plants	M-ERA.NET ExploGuard	9/2014-8/2017	33333	W
2015	Leightweight nanocrystalline aluminium based material for space applications (modeling and technology verfication)	M-ERA.NET RUSPLUS	10/2015-9/2016	0	W

2.4.2. Other international projects, incl. total funding and funding for the institute

1)

Title of the project:	**Effect of dispersion particles on structure formation and properties of nanocomposites prepared by SPD method**
Slovak title:	Vplyv disperzných častíc na formovanie štruktúry a vlastností nanokompozitov pripravovaných PVD metódou
Type of project/Program:	*(MAD)* Inter-Academic Exchange Programme
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Michal Besterci** (IMRSAS) – coordinator
Duration:	1.1.2012 / 31.12.2013
Financial support:	2012 - 752 €

2)

Title of the project:	**Optimalization of silicon nitride based composites with carbon nanotubes and graphene**
Slovak title:	Optimalizácia kompozitov na báze nitridov kremíka s uhlíkovými nanotrubicami a grafénom
Type of project/Program:	*(MAD)* Inter-Academic Exchange Programme

Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** – (IMRSAS) – coordinator
Duration:	1.7.2010 / 30.9.2012

3)

Title of the project:	**Calcium phosphate based biomaterials utilized in medicine**
Slovak title:	Kalcium fosfátové biomateriály využiteľné v lekárstve
Type of project/Program:	*(MAD)* Inter-Academic Exchange Programme
Responsible person in the organisation and his/her status in the project:	**Dr. Ľubomír Medvecký** – (IMRSAS) – coordinator
Duration:	17.12.2009 / 16.12.2012

4)

Title of the project:	**Investigation of Behaviour of carbon Coated Alloyed Powders during Sintering and Modelling of the Sintering Process**
Slovak title:	Štúdium správania sa uhlíkom povlakovaných legovaných práškov počas spekania a modelovanie procesu spekania
Type of project/Program:	*(MAD)* Inter-Academic Exchange Programme
Responsible person in the organisation and his/her status in the project:	**Dr. Marcela Selecká** – (IMRSAS) – coordinator
Duration:	1.1.2012 / 31.12.2014

5)

Title of the project:	**Modeling of phase diagrams of systems with boron**
Slovak title:	Modelovanie fázových diagramov systémov s bórom
Type of project/Program:	*(MAD)* Inter-Academic Exchange Programme SAV-AV ČR 15-11
Responsible person in the organisation and his/her status in the project:	**Dr. Viera Homolová** – (IMRSAS) – coordinator
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - 1365 €

6)

Title of the project:	**Preparation and characterization of soft magnetic high entropy alloys**
Slovak title:	Príprava a charakterizácia magneticky mäkkých zliatin s vysokou entropiou
Type of project/Program:	*(MAD)* Inter-Academic Exchange Programme SAV-AV ČR 15-08
Responsible person in the organisation and his/her status in the project:	**Dr. Magdaléna Strečková** – (IMRSAS) – coordinator
Duration:	1.1.2015 / 31.12.2017
Financial support:	2015 - 1451 €

2.4.3. Other important, international projects and collaborations without direct funding (max. 10 projects)

1)

Title of the project:	**Preparation and characterisation of organic-inorganic composites based on polyurethan-X systems**
Slovak title:	Príprava a charakterizácia organicko-anorganických kompozitov na báze polyuretán-X systémov
Type of project/Program:	Bilateral Project
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** – (IMRSAS) – coordinator
Duration:	1.1.2012 / 31.12.2014

2)

Title of the project:	**Room and high temperature indentation testing of WC-Co cemented carbides**
Slovak title:	Indentačné skúšky systému WC-Co pri izbovej teplote a za vysokých teplôt
Type of project/Program:	Bilateral Project
Responsible person in the organisation and his/her status in the project:	**Prof. Dr. Ján Dusza** – (IMRSAS) – coordinator
Duration:	1.8.2013 / 31.7.2015

3)

Title of the project:	**The investigation of structural steels sintered in atmosphere with different chemical composition**
Slovak title:	Výskum konštrukčných ocelí spekaných v atmosférach rôzneho chemického zloženia
Type of project/Program:	Bilateral Project
Responsible person in the organisation and his/her status in the project:	**Dr. Miriam Kupková** – (IMRSAS) – coordinator
Duration:	1.8.2013 / 31.12.2015

- ## National projects and their funding

2.4.4. Projects supported by the Slovak Research and Development Agency (APVV)

Role of the Institute e.g. coordinator “C”, investigator “I”.

	Project title	Typ / Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute / Responsible person
2012	Microstructure and properties of powder micro and nano-composite materials for middle freguency aplications	APVV-0222-10	05/2011-10/2014	119261	C
	High temperature oxidation resistant nanocomposite coatings with improved lifetime	APVV-0520-10	05/2011-12/2013	67993	C
	Development of composite biomaterials based on silicon nitride	APVV-0500-10	05/2011-10/2014	31687	W
	Application of progressive tool coatings for increasing the effectiveness and productivity of forming sheets made of modern materials	APVV-0682-11	07/2012-06/2015	98702	W
	Mechanisms of corrosion and micromechanical properties of dental materials	APVV-0218-11	07/2012-12/2015	35963	W
	High-strengh electro-technical composite steels	APVV-0147-11	07/2012-12/2015	175757	C
	Biodegradable metallic materials prepared by powder technologies	APVV-0677-11	07/2012-12/2015	126117	C
	Study of the Processes of Coating and Formation of Nano-Structured Active Carbon at Processing of Low Alloyed Sintered Steel Components from Powder Mixtures	SK-BG-0032-10	01/2012-12/2013	1549	C
	Development of Si3N4 with addition of graphene platelets	APVV-0161-11	07/2012-12/2015	154503	C
2013	Development of SiC based conductive ceramics	APVV-0108-12	10/2013-09/2017	67871	C
2014					
2015	Silicon oxynitride-based photoluminecent ceramic materials	APVV-14-0385	07/2015-06/2019	6814	W
	Increasing the quality of cut-outs and effectiveness of cutting electric sheets	APVV-14-0834	07/2015-06/2018	20198	W
	Development of new generation joints of powerelectronics using nonsandard Sn-based alloys	APVV-14-0085	07/2015-06/2018	9678	W
	Multicomponent nanocomposite coatings prepared by highly ionized deposition technologies	APVV-14-0173	07/2015-06/2018	30699	C
	Chalcogenite glasses/netal nanoparticles nanocomposites for plasmonics	SK-UA-2013-0046	09/2015-12/2016	91	C
	Study of welds and heat effected zones of bimetals	SK-CZ-2013-0164	01/2015-12/2015	1803	C
	Progresive soft magnetic materials base on multicomponent alloys	SK-CZ-2013-0150	01/2015-12/2015	2652	C
	Investigation of mechanical and fracture behavior of nanoceramic composites reinforced by boron nitride nanotubes	SK-CZ-2013-0194	01/2015-12/2015	1389	C

2.4.5. Projects supported by the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA) for each year, and their funding

VEGA	2012	2013	2014	2015
Number	17	17	18	20
Funding in the year (EUR)	112147	122226	106822	135458

[1]

- **Summary of funding from external resources**
-

2.4.6. List of projects supported by EU Structural Funds

2.4.7. Summary of external resources of the EU Structural Funds (ERDF/ESF)

Role of the Institute in the project, e.g. coordinator “C”, work package leader “W”, investigator “I”.

Year	Project title	Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute
2012	Advanced technology of preparation of micro-composite materials for electrotechnics	26220220105	12/2010-03/2015	389180	C
	New Materials and Technology for energetics	26220220061	09/2010-08/2013	282350	W
	Infrastructure Improving of Centre of Excellence of Advanced Materials with Nano - and Submicron - structure	26220120035	5/2010-4/2013	291326	C
	Centre of Excellence of Ceramics, Glasses and Silicates	26220120056	9/2010-08/2013	229843	W
	Slovak Research-Innovation Platform on Sustainable Mineral Resources	26220220053	01/2010-06/2013	25218	W
	Research Centrum for Combinated and Renewable Resources of Energy	26220220064	06/2010-12/2013	39951	W
	Technology of preparation of electrical steels possessing high permeability for high affectivity electromotors	26220220037	01/2010-06/2012	19503	C
	Improvement of utilization of sophisticated equipment and methods in research and education at IMR SAS	261102301054	01/2012-12/2012	342484	C
	Center of excellence of biomedical technologies	26220120066	11/2010-10/2013	70425	W
	Advanced implants seeded with stem cells for hard tissue regeneration and reconstruction	26220220032	01/2010-03/2012	61797	C
2013	Research centre of Advanced Materials and Technologies for Recent and Future Applications "PROMATECH"	26220220186	08/2013-07/2015	448246	W
2014					
2015					

[1] Excluding projects for the popularisation of science

External resources	2012	2013	2014	2015	total	average
External resources (milions of EUR)	1,662	1,125	0,284	0,464	3,535	0,884
External resources transfered to coooperating research institute (milions of EUR)	0,748	0,569	0,006	0,012	1,335	0,334

- **Supplementary information and/or comments on research projects and funding sources**

2.5. PhD studies and educational activities

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

5.2.26 - Materials - study programme: Materials Science and Materials Engineering

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

PhD study	12/31/2012			12/31/2013			12/31/2014			12/31/2015		
Number of potential PhD supervisors	20			20			20			20		
PhD students	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted
Internal	13,0	0,0	1,0	13,0	3,0	0,0	15,0	1,0	1,0	14,0	3,0	0,0
External	2,0	0,0	0,0	1,0	1,0	0,0	1,0	0,0	0,0	1,0	0,0	0,0
Other supervised by the research employees of the institute												

Internationalization of PhD studies: foreign PhD students on work stays at IMR SAS

2013		
M.Sc. Tamás Csanádi	ELTE University, Faculty of Science, Budapest, Hungary	55 days
2015		
Ing. Roman Husák	Ústav fyziky materiálů AV ČR, Brno, Czech Republic	39 days
MSc. Billel Cheniti	University of Science and Technology Houari Boumedienne, BP 32 El Alia 16111, Bab Ezzouar, Algeria	31 days
MSc. Marek Klich	Lodz University of Technology, Lodz, Poland	60 days

Internationalization of PhD studies: PhD students from IMR SAS on work stays abroad

2012

Ing. Annamária Duszová	Institute of Metallurgy and Materials Science of Polish Academy of Sciences, Krakow, Poland	55 days

2013

Ing. Annamária Duszová	Institute of Metallurgy and Materials Science of Polish Academy of Sciences, Krakow, Poland	36 days

2.5.3. Summary table on educational activities

Teaching	2012	2013	2014	2015
Lectures (hours/year)[2]	56	63	124	30
Practicum courses (hours/year)[2]	60	54	51	22
Supervised bachelor theses (in total)	1	0	1	0
Supervised diploma theses (in total)	14	8	6	4
Supervised PhD theses (in total)	0	4	1	3
Members in PhD committees (in total)	8	8	9	11
Members in DrSc. committees (in total)	2	2	1	1
Members in university/faculty councils (in total)	3	3	3	2
Members in habilitation/inauguration committees (in total)	4	1	1	1

2

2.5.4. List of published university textbooks

2.5.5. Number of published academic course books

2.5.6. List of joint research laboratories/facilities with universities

[1] **Name of university/college and faculty**: The University of Pavol Jozef Safarik in Kosice
Type of cooperation (joint work or other): Centre of Excellence in Advanced Materials Nano and Submicron Structure
Start of cooperation: 2009
Focus: Project SF
Evaluation: The Centre of Excellence (CE) based on Institute of Material Research (IMR) SAS Košice creates the workplace with infrastructure for research and development in nanotechnology and advanced materials with nano and submicron structure to implement cutting-edge research of international cooperation in nanotechnology and advanced materials with nano submicron structure and promote the transfer of acquired knowledge into practice.

Partners of CE are University of Pavol Jozej Safarik (UPJS), Institute of Experimental Physics SAS (IEP) and Institute of Geotechnics SAS (IGT).

[2] Do not include time spent with bachelor, diploma or PhD students during their supervising

[2] **Name of university/college and faculty**: The University of Pavol Jozef Safarik in Kosice
Type of cooperation (joint work or other): Joint Laboratory of transmission electron microscopy
Start of cooperation: 2011
Focus: Teaching area, Science education, The joint laboratory
Evaluation: In this laboratory on the same premises PF UPJS operated transmission electron microscope JEOL 2100 F with high resolution. The activities SLTEM of the partnership involved Institute of Experimental Physics SAS (IEP) and Institute of Geotechnics SAS (IGT). The joint laboratory is organizationally integrated into the organizational structure of the partners and is governed by its own statute.

[3] **Name of the university/faculty:** The Technical University of Košice
Matter of cooperation (joint laboratory or other): Joint Laboratory of Scanning Electron Microscopy
Start of cooperation: 2006
Focus of activity: education, scientific education, joint laboratory
Assessment: Scope of the laboratory is operation and usage of the high resolution scanning electron microscope JEOL JSM-7000F installed in premisses of the Institute of Materials Research of the Slovak Academy of Sciences. The microscope is equipped by field emission gun and Microanalytical unit INCA Energy 250, Microanalysis System (EDS) and HKL Chanel 5 (EBSD), all from the Oxford Instruments co. The joint laboratory is organisationally integrated into the Department of Microstructural and Chemical Analyses of the Institute and is administrate according its status.

[4] **Name of university/college and faculty**: The Technical University of Košice
Type of cooperation (joint work or other): Joint research and innovation platform for sustainable sources of raw materials
Start of cooperation: 2011
Focus: Teaching area, Science education, Research and Development, Development-Implementation work
Evaluation: In cooperation activities will be focused on the integration of research capacities of universities and institutes participating SAS, allowing effectively to carry out research, development and innovation activities in the mining and processing of raw materials and transfer research results into practice in terms of concrete innovation projects.
The partners in the platforms are BERG Faculty and Faculty of Metallurgy TU Košice, IGT SAS and IMR SAS.

[5] **Name of university/college and faculty**: Alexander Dubček University in Trenčín
Type of cooperation (joint work or other): Centre of excellence of ceramics, glass, and silicate materials (CEKSIM)
Start of cooperation: 2013
Focus: teaching, scientific training, common laboratory
Evaluation: active collaboration in the field of advanced silicate based ceramics, glasses, and silicate matrix materials, common workshops and seminar, frequent visits and use of laboratories for preparation and characterization of prepared materials.

- **Supplementary information and/or comments on doctoral studies and educational activities**

2.6. Social impact

2.6.1. List of the most important results of applied research projects. Max. 10 items

1. Treatment of electro-technical steel for electric motors with higher efficiency
Project ITMS 26220220064, Research centre for efficiency of integration of combined systems of renewable energy sources (Centrum výskumu účinnosti integrácie

kombinovaných systémov obnoviteľných zdrojov energií), principal investigator RNDr. F. Kováč, CSc., authors: F.Kováč, I. Petryshynets
The new technological process of heat treatment segments of the electric motor was designed, based on the use of the process of deformation induced ferrite grain growth in order to increase the intensity of cubic and Goss texture components. Measurements on two electric motors containing stator and rotor segments heat treated at IMR by the newly developed dynamic regime aimed at utilizing a process of deformation induced grain boundary movement, were carried out according to EN 12900 in order to find the impact of torque on the motor efficiency. The measured showed an important fact that in whole load range the tested electric motors exhibited higher efficiency.

2. Preparation of biocement mixture containig nanocrystalline monetit
VEGA 2/0026/11: Composite biocement-biopolymer systems with addition of surfactants, principal investigator Ing. Ľ. Medvecký, PhD.
The new method of the preparation of tetracalcium phosphate biocement with nanocrystalline monetite was developed. The final compressive strength was around 40 MPa and the pH value of cement paste was reduced down to 8.4, which ensures lowering of the surrounding tissue irritation during first stages of cement applying. The given cement powder mixture will be utilized on the preparation and testing composite systems with biopolymer component.
MEDVECKÝ, Ľ.: The method of preparation of calcium phosphate cements precursor mixture. Patent application PP 00049-2012

2013
1. Preparation of magnetically soft composites with polymer insulating binder
Projects APVV-0222-10 "Magnetically soft composites consisting of ferromagnetic powder particles coated with electroinsulating layer ", principal investigator doc. E. Dudrová, CSc.; VEGA 2/015/12 "Preparation, microstructure and properties of magnetic composites based on ferrous powder ", principal investigator Ing. R. Bureš, CSc. and project ITMS 26220220105 "Advanced technology of preparation of micro-cromposite electrical engineering materials", principal investigator Ing. R. Bureš, CSc.

Boron-modified phenol-formaldehyde resin (PFRB) was applied to the surface of the magnetic materials of different morphology from which the composites were compacted. On the composites prepared from ferromagnets based on ASC100.29 with the addition of 3 wt.% PFRB the impact of compaction parameters on physical properties was investigated. The aim was to obtain predictable mechanical and magnetic properties. By changing the parameters of the curing cycle following features were achieved: i) after 12 points cycle lasting 28 hours, HV10 = 285, TRS = 12 MPa, R = 2500 μΩm, P_t @ (f = 10kHz, B_{max} = 0,1T) = 54 W / kg, μ_i = 54, HC (DC measurement, B_{max} = 0,1T) = 170 A / m .; ii) after 11 points cycle lasting 21 hours, HV10 = 270, TRS = 95 MPa, R = 1600 μΩm, P_t@ (f = 10kHz, B_{max} = 0,1T) = 54 W / kg, μ_i = 54, HC (DC measurement, B_{max} = 0,1T) = 114 A / m.
The findings lead to a patent application:
BUREŠ, Radovan - STREČKOVÁ, Magdaléna - FÁBEROVÁ, Mária - KOLLÁR, P. - FÜZER, J. Method of preparation of magnetically soft composites with polymer electro insulating binder: Patent application: PP 00095-2013. Banská Bystrica : ÚPV SR, 2013.

2. Development of superhard protective PE CVD WC coatings
Projects VEGA 2/0108/11 and APVV-0520-10 "Enhancement of oxidation resistance and hardness of PE CVD W-C coatings", principal investigator doc. RNDr. F. Lofaj, DrSc.

By optimizing the deposition conditions in the case of PE CVD coatings WC it was possible to increase the hardness from conventional 15-20 GPa to 28.5 ± 2 GPa, at coefficient of friction of 0.77. The minimum coefficient of friction was 0.12, but the hardness of the coating in this case decreased to 14.6 ± 1.7 GPa and the Young's modulus to 152 ± 7 GPa. Increase of the coefficient of friction up to 0.7 to 0.8 is connected to a lack of free carbon with a lubricating effect and to creating of oxides of iron (steel balls) and tungsten due to tribo reactions in surface microcontacts. When using precursor and C_2H_2 nanocomposite structure WC_{1-x} formed in a carbon matrix, causing a decrease in hardness, but also a

significant reduction in the coefficient of friction. The combination of precursor $W(CO)_6$ and mixtures of SiH_4 + N_2 resulted in a modest decrease in hardness with a significant reduction in the coefficient of friction: under optimized conditions of preparation the nanoindentation hardness of coatings was 26.9 ± 0.9 GPa, indentation module was 221 ± 21 GPa and coefficient of friction 0.35.
In the W-C coatings applied by DC magnetron sputtering maximum indentation hardness of 37.2 ± 4.8 GPa and indentation modulus 447 ± 28 GPa with a coefficient of friction of 0.64 were achieved. At the same time reduction of the compressive stress in this coating only to 0.5 GPa took place. In CrN coatings deposited by DC magnetron sputtering the indentation hardness of 26.2 ± 2 GPa and indentation modulus 180 ± 28 GPa were found. The lowest coefficient of friction of 0.2 was achieved for coatings with hardness 22 GPa. When studying the residual stress in the WC and Cr-N coatings it has been found that the compressive stresses in the coatings increase with increasing pressure and bias, and decrease with increasing film thickness. Above the thickness of 1.4 mm they reach values below 1 GPa. Also, increasing linear relationship of nanoindentation hardness (range 16 GPa to 20 GPa) on compressive stress (in the range of 1.75 GPa and 4.5 GPa) was observed with the tangent close to 1.

3. Effect of stress concentrators on tensile properties of dual phase steels
Project VEGA 2/00192/12 "Evaluation of strain and fracture properties of dual-phase steels on miniature samples", principal investigator doc. Ing. G. Rosenberg, CSc.
Effect of stress concentrators on tensile properties of dual phase steels was investigated. Various methods (smooth samples, samples with drilled hole, Charpy testing) showed that with increasing deformation localization the effect of stress concentrators on energy absorption ability of DP steels also increased in dependence on intercritical hardening. Minimum absorption ability was observed after hardening from 740°C, i.e. on samples with the lowest OPM.
It was shown that for description of fracture behaviour of steels at impact load the significance of experimental determination of process zone size in the vicinity of the crack tip increases for decreasing sample cross section.

2014

1. Optimization of the structure and properties of heat affected zone weld of T92 steel by modifying the conditions of heat treatment
Project VEGA 2/0116/13 “Structure modification of the heat affected zone of welded joints of modern 9Cr ferritic creep resistant steels with boron with aim to improve their creep resistance and toughness”, principal investigator: Ing. Ladislav Falat, PhD.
While studying the influence of heat treatment parameters after welding on structure and properties of weld joints of 9Cr-0,5Mo-1,8W-VNb T92 steel doped by boron were, using the thermodynamical modelling, determined its transformation characteristics in order to predict the critical temperatures of phase transformation of solid solutions as well as the regions of stability of precipitating secondary phases. The obtained results were verified by difference scanning calorimetry and complex metallographic analysis. This approach allowed to design an optimized two-stage heat treatment of welded joints with the aim of microstructure homogenization. The mentioned treatment at the same time reduced the amount of non-equilibrium delta-ferrite and thus improving the mechanical properties and creep resistance of the investigated welded joints.
L. Falat, L. Čiripová, J. Kepič, J. Buršík, I. Podstranská. Correlation between microstructure and creep performance of martensitic/austenitic transition weldment in dependence of its post-weld heat treatment. Engineering Failure Analysis 40 (2014) 141-152. (1.130 - IF2013). ISSN 1350-6307.

2. Effect of intercritical hardening on deformation and fracture behaviour of steel at static, impact and cyclic loading.
Project VEGA 2/00192/12 "Evaluation of strain and fracture properties of dual-phase steels on miniature samples", principal investigator doc. Ing. G. Rosenberg, CSc.
During the work on the project a simple tester was designed and fabricated, which together with a light microscope and a CCD camera enabled in-situ observation of development of

local deformations. By means of this device further series of experiments were carried out on samples with various geometries including miniature samples. They wre primarily aimed at assessment of effect of intercritical hardening temperature on deformation and fracture behaviour of steels at static, impact and cyclic loadings. The experiments performed on samples hardened in the range of 740 - 900°C confirmed the previous results that in contrast to the static toughness the lowest ability to absorb impact energy and also the lowest fatigue resistance have the samples hardened from 740°C.
Nanohardness measurements of both co-existing phases (ferrite + martensite) in the DP steels showed that at this temperature of hardening martensite has the highest hardness. This showed that the low damage resistance was caused by large difference in hardness/strength of both phases, which causes high intensity of local plastic deformation, which consequently accelerates the processes connected to crack initiation, particularly at dynamical loading (impact and cyclic). Higher fatigue crack growth resistance observed in steels with ferrite(F)+martensite(M) structure in comparison to ferrite-pearlite structure is the results of martensite blocking of slip strips from fatigue crack tips, i.e. the F-M steels have smaller plastic zone. The results contributed to finalization of development of new low carbon DP steel primarily for automotive industry with good cold workability despite its high strength (over 1000 MPa.).
G. Rosenberg, I. Sinaiová, M. Kočík: Analýza náchylnosti dvojfázových ocelí ku lokalizácii plastickej deformácie. Strojírenská technologie 19 (2014) 10/12 220-227.

2015

1) High strength isotropic electro-technic steel with composite structure

Project APVV -0147-011 „High strength electro-technic composite steels“, principal investigator RNDr. František Kováč, CSc. investigator Mgr. Ivan Petryshynets, PhD.
The finding concerns a new concept of microstructural high strength non-oriented electrical steel. Base of this concept is a composite microstructure and substructure arrangement across the sheet thickness, where the subsurface region primarily exhibits high strength properties and microstructure in the central area ensures good electromagnetic properties. The composite morphology of the microstructure consists of two surfaces between 0.02 to 0.2 of sheet thickness, where this layer consists of fine ferritic grain with mean size from 5 microns to 25 microns strengthened by fine VC precipitates and other carbides with size up to 100nm. This layer is characterized by a tensile strength of 600 MPa to 1000 MPa. The central layer of the thickness of the sheet is made up of coarse ferritic grain with a mean size of 30 to 200 microns reinforced by solid solution of elements in the matrix, where the overall percentage of the secondary particles in the layer is 0.005 volume percent. The composite microstructure provides a combination of high strength and excellent electromagnetic properties, with good resistance to dynamic fatigue. This combination of properties of steel allows its application for the construction of the rotor cores for electric and hybrid drives and electric motors operating at high speeds and with rapid changes of rotation causing high speed centrifugal force.
F. Kováč, I. Petryshynets: Vysokopevná izotrópna elektrotechnická oceľ s kompozitnou mikroštruktúrou : Podaná patentová prihláška č. PP 00090-2015. Banská Bystrica : ÚPV SR, 2015.

2) Reduction of stress in dental implants

Project VEGA 2/0098/14 “Modelling of stress states at nanoindentation and mechanical loading in composite systems (MONACO)”, principal investigator: Doc. RNDr. František Lofaj, investigator Ing. Dušan Németh

- multi axis loading of dental implant generates in cortical bone compressive stresses concentrated in the root of the first thread of the implant.
- Shortening of the implant and thinning of the cortical bone leads to significant increase of maximum stresses in the cortical bone and to shortening the lifetime of the implant due to bone degradation.
- Bicortical fixing of the implant brings only minimumu reduction of stress concentration in comparison to monocortical fixing.
- Maximum compressive stresses in the cortical bone and the implant lifetime extension can be more effectively achieved by inserting the implant under the cortical bone surface.

LOFAJ, F. - KUČERA, J. - NÉMETH, D. - KVETKOVÁ, L.: Finite element analysis of stress distributions in mono- and bi-cortical dental implants. Materials Science and Engineering C, 50, 2015, s.85-96

3) Excellent bending properties of HSLA steel caused by presence of Mo-Ti nano-precipitates with size <5nm.

Project VEGA 2/0176/15 “The effect of chemical composition and microstructure of the dual phase steel susceptibility to hydrogen embrittlement”, principal investigator: Doc. Ing. Gejza Rosenberg, CSc.

The main limiting factors that prevent wider use of ultra-high strength dual-phase steels (over 1000 MPa) in the automotive industry is their poor formability, a consequence of the large difference in hardness between the soft ferritic matrix and a hard martensite phase as well as so called softening occurring in the heat affected zone of welded sheets – a result of tempering of martensite and/or too low thermal stability of precipitates. Following the results achieved in the previous project (VEGA 2/0192/12), large-scale systematic experiments were carried out on eight cast steels in the form of processed ~20 kg ingots. Controlled hot rolling and cold rolling followed by intercritical hardening at 750°C and 800°C were performed. Additionally, the interaction between the recrystallization of ferrite and austenite grain forming and the relationship between microstructure and properties of steel rolled and cold body was observed. It was found that for steels having a nominal chemical composition of 12:15-C-1.2Mn-0.02s-0.1Ti-0.2m, which was after cold rolling intercritically hardened, despite its strength of over 1000 MPa a high bendability (bending by 180 ° C with the radius of curvature of 0.5 mm) may be achieved thanks to the presence of nano-precipitates (<5 nm), which are more or less homogeneously distributed in the ferrite fine grains (<2 μm). A very important finding is that the steel had among all the studied steels the highest resistance to softening at 650 ° C, including resistance to growth of austenite grains even at high temperatures such as 1000 ° C.

In addition to that, the combined effect of natural aging (4-year period) for the two mechanical properties of hot rolled strip (X70 micro-alloyed steel and structural steel S355) was studied. Static tests were carried out on samples with and without stress concentrators, as well as Charpy impact tests with a V-notch. Tests of susceptibility to hydrogen embrittlement of steels also included the examination of microstructural heterogeneity across the thickness of the steel strip (including the occurrence of segregation zones). The development of local plastic deformation during the deformation process and the measurement of the plastic area around the drilled holes and notches was studied by the scanning electron microscope and with the help of a differential interference contrast light microscope. Experimental results have shown that hydrogen may cause different types of damage depending on the structural state of steels and test conditions. A new methodology for testing the susceptibility of materials to hydrogen embrittlement was designed.

G. Rosenberg, I. Sinaiová, P. Hvizdoš, Ľ. Juhar, Metallurgical and Materials Transactions A, 46, 2015, 4755-4771

4) Identification of the incidence and causes of formation of brittle boride phases in the melting zone of heterogeneous welded joints of creep resistant 92 martensitic steel

VEGA 2/0116/13, principal investigator Ing. Ladislav Falat, PhD. and VEGA 2/0153/15, principal investigator RNDr. Viera Homolová, PhD.

The local presence of brittle borides of the niobium layer was identified in dissimilar weld joints of martensitic creep resistant steel grade 92 and the Ni-rich weld metal (Ni WM). The systematic analysis of the material conditions taking into account the different conditions of heat treatment after welding, of long term isothermal exposure and mechanical testing, it was found that the occurrence of the mentioned boride phases ire independent of the above factors, and are only connected with the melt-mixing and subsequent segregation and chemical interaction of Nb and B during solidification. Narrowly localized incidence of the identified niobium borides is given by the degree of mixing of Nb-containing Ni WM and B-containing martensitic steels.

Morphology of continuous, secondarily cracked boride layers observed on the fracture surface was an indication of their formation at the end of the process of solidification of the

melt zone, which was confirmed by thermodynamic calculations simulating the evolution of phase composition depending on the temperature and chemical composition variations. The localized occurrence of brittle boride phases indicates a potential risk in terms of their preferential degradation and failure of real pressure vessel structures. The obtained data indicate that possibilities for prevention of brittle phases formation in dissimilar welded joints of martensitic steels should be based on optimization of the welding conditions and the development of additives for welding advanced creep resistant boron doped steels. [1]

[1] A. Výrostková, J. Kepič, V. Homolová, L. Falat. Precipitation of niobium boride phases at the base metal/weld metal interface in dissimilar weld joints. Journal of Materials Engineering and Performance, 2015, vol. 24, no. 7, p. 2699-2708. (0.998 - IF2014). ISSN 1059-9495.

2.6.2. List of the most important studies commissioned for the decision-making authorities, the government and NGOs, international and foreign institutes

2.6.3. List of contracts and research projects with industrial and other commercial partners, incl. revenues

2012

ZVS HOLDING, a.s.Dubnica nad Váhom	150,00 €
Mops Press, s.r.o. Snina	2200,00 €
ZVS HOLDING, a.s.Dubnica nad Váhom	150,00 €
Mops Press, s.r.o. Snina	600,00 €
Mops Press, s.r.o. Snina	227,00 €
MAKSD, s.r.o. Nováky	300,00 €
AD Technika, s.r.o. Košice	280,00 €
Mops Press, s.r.o. Snina	450,00 €
ÚEF SAV, Košice	400,00 €
Mops Press, s.r.o. Snina .	600,00 €
Mops Press, s.r.o. Snina	600,00 €
SEZ Krompachy, a.s.	284,55 €
Delta Defence , a.s. Prešov	198,00 €
VÚZ-PI SR, Bratislava	600,00 €
Žel. Podbrezová VVC, s.r.o.	800,00 €
Embraco Slovakia, s.r.o. Spišská Nová Ves	1600,00 €
ÚGT SAV, Košice	300,00 €
Spinea, s.r.o. Prešov	917,10 €
ALCAST, a.s. Snina	208,00 €
Regada, s.r.o. Prešov	6541,03 €
Total/2012	**17405,68** €

2013

Mops Press, s.r.o. Snina	750,00 €
Spinea, s.r.o. Prešov	1953,88 €
ZVS HOLDING, a.s. Dubnica nad Váhom	450,00 €
EL, s.r.o. Spišská Nová Ves	1200,00 €
HOBES Slovakia, s.r.o. Trebišov	280,00 €
STATON, s.r.o. Turany	998,00 €
HOBES Slovakia, s.r.o. Trebišov	240,00 €
Žel. Podbrezová VVC, s.r.o.	150,00 €
CEIT SK, s.r.o. Žilina	4900,00 €
Univerzitné centrum Zvolen, n.o.	150,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	300,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	200,00 €
CHROMSPEC Slovakia, s.r.o. Šaľa	500,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	250,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	100,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	150,00 €
Magneti Marelli PWT Slovakia, s.r.o. Bratislava	2001,60 €

ZVS HOLDING, a.s. Dubnica nad Váhom	150,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	200,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	200,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	150,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	150,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	400,00 €
HOBES Slovakia, s.r.o. Trebišov	185,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	400,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	300,00 €
TERICHEM, a.s. Svit	1300,60 €
RF, s.r.o. Malacky	650,00 €
ZVS HOLDING, a.s. Dubnica nad Váhom	250,00 €
BELT & BUCKLE, s.r.o. Žilina	700,00 €
VÚZ–PI SR Bratislava	1200,00 €
Hornonitrianske bane, a.s. Prievidza	650,00 €
ALCAST, a.s. Snina	214,80 €
Regada, s.r.o. Prešov	6677,39 €
Total/2013	**28351,27** €

Work contracts invoiced in 2013

Ústav mat. a mech. Strojov	
SAV-Bratislav Zmluva o dielo 9/1706/2013	8750,00 €
ŽP, a.s. Podbrezová Zmluva o dielo 2/2011	55200,00 €

2014

Technická univ. vo Zvolene, Zvolen	400,00 €
Magneti Marelli PWT Slovakia, Kechnec	4930,80 €
ZVS Holding, a.s., Dubnica nad Váhom	150,00 €
ZVS Holding, a.s., Dubnica nad Váhom	150,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
ZVS Holding, a.s., Dubnica nad Váhom	350,00 €
MOPS PRESS, s.r.o., Snina	300,00 €
CorOne, s.r.o., Košice	216,45 €
HOBES Slovakia, s.r.o., Trebišov	800,00 €
Turkiye Sise ve Cam Fabrikalari, a.a., Istanbul, Turkey	360,00 €
Slovenská technická univerzita, Bratislava	144,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
UPJŠ, Košice	400,00 €
ÚEF SAV, Košice	200,00 €
STATON, s.r.o., Turany	750,00 €
ELBA, a.s., Kremnica	1603,88 €
Vysoká škola báňská TU Ostrava, ČR	1100,00 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €
Technická univerzita, Košice	600,00 €
TM Precision Mechanical Production, s.r.o. Michalovce	200,00 €
ŽP VVC, s.r.o., Podbrezová	200,00 €
ZVS Holding, a.s., Dubnica nad Váhom	350,00 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €
Slovenská technická univerzita, Bratislava	800,00 €
MOPS PRESS, s.r.o., Snina	900,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €
ZVS Holding, a.s., Dubnica nad Váhom	150,00 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €

ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
ZVS Holding, a.s., Dubnica nad Váhom	200,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
Turkiye Sise ve Cam Fabrikalari, a.a., Gebze–Kocaeli, Turkey	360,00 €
ŽP VVC, s.r.o., Podbrezová	350,48 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €
CASSPOS, a.s., Košice	1400,00 €
FVT TU v Košiciach so sídlom v Prešove	2349,00 €
Miba Sinter Slovakia, s.r.o. Dolný Kubín	2700,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
Vysoká škola báňská TU Ostrava, ČR	510,50 €
HOBES Slovakia, s.r.o., Trebišov	200,00 €
Ústav geoniky AV ČR, v.v.i. Ostrava Poruba, ČR	2501,97 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €
Miba Sinter Slovakia, s.r.o. Dolný Kubín	1788,60 €
Magneti Marelli PWT Slovakia, Kechnec	5268,24 €
ZVS Holding, a.s., Dubnica nad Váhom	100,00 €
Vysoká škola báňská TU Ostrava, ČR.	107,06 €
Vysoká škola báňská TU Ostrava, ČR.	453,43 €
Regada, s.r.o. Prešov	7639,60 €
Total/2014	**43534,01 €**

2015

ZVS Holding, a.s., Dubnica nad Váhom	300,00 €
ZVS Holding, a.s., Dubnica nad Váhom	300,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
Miba Sinter Slovakia s.r.o., Dolný Kubín	2926,80 €
Mops Press, s.r.o., Snina	2179,85 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
TM Precision Mechanical Production, s.r.o., Michalovce	150,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
Fecupral, s.r.o., Veľký Šariš	40,65 €
YAZAKI Wiring TechnologiesSlovakia, s.r.o., Michalovce	247,45 €
Neukor, s.r.o., Košice	360,75 €
MUDr. Jozef Minčík, PhD., Zubná ambulancia, Košice	400,00 €
Fecupral, s.r.o., Veľký Šariš	375,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
Mops Press, s.r.o., Snina	2800,00 €
Strojnícka fakulta TU v Košiciach, Košice	3500,00 €
Mops Press, s.r.o., Snina	1600,00 €
Strojnícka fakulta TU v Košiciach, Košice	550,00 €
Elba, a.s., Kremnica	1970,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
STATON, s.r.o., Turany	300,00 €
Magneti Marelli PWT Slovakia, s.r.o., Kechnec	4900,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
Mgr. Timea Coculová, Košice	40,65 €
Mops Press, s.r.o., Snina	800,00 €
ZVS Holding, a.s., Dubnica nad Váhom	250,00 €
Spinea, s.r.o., Prešov	406,50 €
Elba, a.s., Kremnica	400,00 €
Magneti Marelli PWT Slovakia, s.r.o., Kechnec	4999,00 €

Mops Press, s.r.o., Snina	1600,00 €
ZVS Holding, a.s., Dubnica nad Váhom	500,00 €
Mops Press, s.r.o., Snina	2400,00 €
Vítkovice Cylinders, a.s., Ostrava-Vítkovice, ČR	250,00 €
Tesla Stropkov, a.s., Stropkov	732,00 €
Ústav experimentálnej fyziky SAV, Košice	200,00 €
Strojnícka fakulta TU Košice	996,10 €
ZVS Holding, a.s., Dubnica nad Váhom	300,00 €
Mops Press, s.r.o., Snina	3200,00 €
Regada, s.r.o. Prešov	8160,91€
Total/2015	**50635,66** €

2.6.4. List of licences sold abroad and in Slovakia, incl. revenues

2.6.5. List of most important social discourses under the leadership or with significant participation of the institute (max. 10 items)

2.6.6. Summary of relevant activities, max. 300 words

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.
In 2012 IMR SAS organized an interesting outreach activity in the form of a series of presentations and discussions with young students and pupils of Kosice schools. It was prepared in the frame of the 7FP project "Immersion in the Science Worlds through the Arts – ISWA". Within the project 7 science popularization films were produced as well as a number of artistic productions supported.
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).
Other important activity is Trans Tech Burza conceived and co-organized by the IMR SAS aim of which is to contribute to technology transfer between industry and academia. In year 2014 and 2015 about 100 participants from both sectors were present with a lot of bilateral negotiations taking place.
The new research Centre PROMATECH established in 2014 organizes through its Brokerage unit a series of one-day workshops for regional industry and academia partners where the new facilities and common interests are presented. In year 2015 three such events took place.
Besides that a great number (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.
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] 9.11.2012: IMR and project MIKROMATEL, infrastructure for research and development of technolgies and materials for electrical engineering - organized at the IMR SAS, lecture for SEZ Krompachy presented Dr. R. Bureš.

[2] 6. 11.2012: Within the European Science and Technology Week, the IMR SAS organized the Doors Open Day, which in its program scheduled lectures and laboratory tour for public. Lecture “Powder metallurgy, sintered metallic powders - why, how, what for? Presented by Assoc. Prof. Dr. E. Dudrová.

[3] 9.10.2012: TV Documentary, STV2 “Vidieť neviditeľné”, Prof. Dr. J. Dusza

[4] 29.3.2012 a 30.3.2012: Documentary: “Scietific popularization films in the project 7.FP ISWA” at IMR SAS, Prof. Dr. J. Dusza

[5] 28. 9. 2012: “Researchers´ Night”, Lecture by Assoc. Prof. Dr. F. Lofaj, shopping centre Optima Košice.

[6] 29.10.2012: “Current status of The European XFEL”, Dr. K. Saksl, Committee for collaboration with XFEL

[7] 2012: “Spektrum vedy”, collaboration on production of the TV documentary, STV2 - Dr. P. Ševc

[8] 10.10.2013: “Propagation of project PROMATECH”, TV and print, Prof. Dr. J. Dusza

[9] 17.1.2013: “Vidieť neviditeľné”, TV2, Prof. Dr. J. Dusza

[10] 12.3.2013: “Properties of radiation. The newest developemtn in FEL sources. Application in structural biology and participation of SR in construction and running the experimental station SFX”, lecture presented by Dr. K. Saksl, Winter School of Synchrotron Radiation 2013, Liptovský Ján

[11] 16.1.2014: “Slovaks and their inventions - Coatings against wear”, Hospodárske noviny, autor: Dr. M. Ferdinandy

[12] 26.9.2014: “Miraculous ceramics around Europe”, lecure, Dr. A. Kovalčíková, Researchers´ Night, Atrium Optima Košice

[13] 15.11.2014: “Interview about the equipment Auriga compact”, TV, autor Dr. R. Podoba

[14] 31.3.2015: “New laboratory - ceremonial opening of the Laboratory of micrwave sintering”, Správy SAV, autor Dr. R. Bureš

[15] 25.3.2015: “Interview in Magazín Rádia Regina”, Radio Regina, autor Dr. P. Hvizdoš, K Saksl

[16] 28.11.2015: “Scientific Lair - Know the world of materials by eyes of technology”, lecture, Interview, interactive happening, autor Dr. A. Kovalčíková, Košice

[17] 31.3.2015: lecture - interview (science café) on the topic “Biomaterials and their use in medicine ", autor Dr. Ľ. Medvecký, http://www.spots.sk/sk/home/to-najlepsie/vedecke-kaviarne/

[18] 25.9.2015: lecture on topic “Free electron lasers, participation of SLovak Republic in XFEL”, autor Dr. K. Saksl, Europen Researchers´ Night, OC Optima Košice

[19] 2015: “Advertising in Guide to Investment in Košice”, autor Dr. P. Hvizdoš, http://www.kosice.sk/static/prilohy/KE_investment_bulletin2015.pdf

[20] 2014, 2015 - TransTechBurza - co-organization of the technology transfer event

2.7.2. Table of outreach activities according to institute annual reports

Outreach activities	2012	2013	2014	2015	total
Articles in press media/internet popularising results of science, in particular those achieved by the Institute	27	5	3	5	40
Appearances in telecommunication media popularising results of science, in particular those achieved by the Institute	1	3	2	2	8
Public popularisation lectures	13	12	29	13	67

- **Supplementary information and/or comments on popularisation activities, max. 300 words**

2.8. Background and management. Human resources and implementation of recommendations from previous assessment

2.8.1. Summary table of personnel

Personnel	2012	2013	2014	2015
All personnel	82,0	86,0	88,0	80,0
Research employees from Tab. Research staff	57,0	61,0	63,0	57,0
FTE from Tab. Research staff	50 ,09	49,790	51,510	48,710
Average age of research employees with university degree	47,1	45,2	46,5	46,3

2.8.1.1. Professional qualification structure (as of 31.12. 2015) FEMALE

FEMALE	AGE								
Number of	< 30	31 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	> 65
DrSc. / prof.	0	0	0	0	0	0	0	0	0
II.a / Assoc. prof.	0	0	1	2	0	0	2	1	1
Other researchers PhD./CSc.	0	4	4	1	2	1	0	1	0
doc. / Assoc. prof.	0	0	0	0	0	0	0	0	0

2.8.1.2. Professional qualification structure (as of 31.12. 2015) MALE

MALE	AGE								
Number of	< 30	31 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	> 65
DrSc. / prof.	0	0	0	1	0	1	2	1	1
II.a / Assoc. prof.	0	0	2	0	3	2	0	2	1
Other researchers PhD./CSc.	1	7	2	1	0	0	2	0	0
doc. / Assoc. prof.	0	0	0	0	0	0	0	0	0

2.8.2. Postdoctoral and mobility scheme

2.8.2.1. Postdoctoral positions supported by national and international resources

SAIA :

Mgr. Vasyl Vasylyovych Kuzma (from 1.9.2014 to 30.6.2015)

Dr. Dmytro Ostroushko (from 1.12.2014 to 30.9.2015)

International Visegrad Fund

Dr. Oleksandr Chobal (from 1.9.2012 to 30.6.2013)

Mgr. Iryna Chobal (from 1.9.2014 to 30.6.2015)

2.8.2.2. Postdoctoral positions supported by external funding

2.8.2.3. SAS stipends and SASPRO stipends

2.8.2.4. Internal funding - the Slovak Academy of Sciences Supporting Fund of Stefan Schwarz

from 1.1.2012 - Dr. Peter Tatarko

from 1.1.2014 - Dr. Annamária Naugthon Duszová

from 1.1.2016 - Dr. Ján Balko (approved 2015)

2.8.3. Important research infrastructure *(max. 2 pages)*

Microstructure and chemical analyses
- Automated grinder and polisher
- Electrolytic polisher (LectroPol-5)
- Ion thinner
- Sputtering machine
- Ion slicer
- Light microscopes (Olympus GX 71, Neophot 32)
- Micro hardness tester
- Scanning electron microscope Jeol JSM 7000F
- Transmission electron microscopy - common laboratory equipped with Jeol JEM -2100F
- Analytical diffractometer Philips X`Pert Pro
- Thermal analyser (NETZSCH DTA-DSC-TG Jupiter STA 449-F1,)
- Nanoindenter Agilent Technology G200

Technology and design
- Equipment for powders compaction, sintering and heat treatment
- Equipment for powder metallurgy production

Mechanical testing

Testing equipment:
- tensile test
- breaking test
- test of fracturing
- bending impact test
- strength in bending
- Vickers, Brinnel and Rockwell hardness testing
- strength in radial compression
- fatigue testing
- fracture toughness tesing: SEPB, SEVNB
- creep in bending, compression and indentation
- thermal shock testing

Laboratories of the PROMATECH Centre
Laboratory of tribotechnology
- nanotribometer CSM NTR2
- high temperature tribometer CSM THT
- universal tribometer Bruker UMT 3

Laboratory for preparation of TEM specimens
- ultrasonic cutter

- disc grinder
- dimple grinder
- ion thinner/polisher PIPS 691
- sputtering machine JEE-420T a Q150T

Laboratory of thermal analyses
- thermal analyser Perkin Elmer DSC 8500

Laboratory for characterization of powder materials
- particle size analyser Mastersizer 2000
- helium pycnometer AccuPyc II 1340

Ceramography laboratory
- ceramographic grinder and polisher TEGRAMIN 30
- equipment for casting/pressing of ceramic samples Simplimet 300
- accurate automated cutter Secotom 15
- low-speed accurate cutter ISOMET 1000
- abrasive wet cutter Delta Abrasimet

Laser laboratory
- laser system TruLaser Station 3003

Laboratory of mechanical testing
- electromechanical universal testing machine Instron 5985
- macro hardness tester Vickers 432SVD
- hardness tester Tukon 1102
- universal hardness tester - model UH250
- resonance fatigue tester Cracktronic

SEM/FIB laboratory
- scanning electron microscope with focused ion beam source CrossBeam systém AURIGA Compact

Laboratory of advanced alloys
- arc furnace MAM-1
- melt spinner verion SC
- attritor 01 SERIES MODELS

Laboratory of „Spark Plasma Sintering“
- SPS, model HP D10-SD od FCT Systeme GmbH, Germany

Laboratory of sintering and heat treatment
- cylindrical muffle sintering furnace CARBOLITE
- chamber hardening furnaces LAC with program controller

Laboratory of micro-nanoindentation
- nanoindenter Agilent G200
- micro-nano indenter TTX NHT

Laboratory of environmental scanning electron microscopy
- environmental scanning electron micrscope cSEMEVO MA15 s EDX/WDX

Nanotechnology laboratory
- electrospinning fiber station nanospiderTMNS LAB 200

Laboratory of light microscopy
- stereomicroscope Stemi 2000 C
- inverted optical microscope Axio Observer 1M

- confocal microscope/optical profiler Neox Plu
- Raman microscop XploRA

Laboratory of chemical surface analyses
- glow discharge emission spectrometer GD - Profiler 2

Laboratory of coating technology
- PVD equipment with HiPIMS and DCMS sources Cryofox Discovery 5000
- HiTUS technology of thin layers and coating sputtering PQL S500

The mentioned infrastructure is fully at the disposal to all scientific staff of the institute, it is used in projects and it is available to scientists and researchers of partner institutions according to particular cooperation agreements.

2.8.4. Description of how the results and suggestions of the previous assessment were taken into account

The previous assessment of the activities of the Institute in 2012 had identified several key areas in which comments for improvement were made. They were summarized into four main suggestions and specific tasks for the organization:

1) To adapt the structure of departments according to the new research objectives.

After thorough analysis and deliberation the restructuralization of the Institute of Materials Research of SAS was prepared over the course of year 2015. The new Organizational statute was proposed and later approved by the Presidium of the Slovak Academy of Sciences in December 2015. The new organizational structure has been in force from the beginning of 2016.

The main gist of the change was that previous seven (eight) scientific departments that were created ad hoc in mid 90s were transformed into three larger scientific divisions. Here, the principle of broader scientific direction and main material systems has been applied. The three divisions deal with 1) metallic materials, 2) ceramic and non-metallic materials, and 3) hybrid and functional materials, respectively. The scientific divisions are of roughly similar size, comparable project potential and experimental capabilities. We believe that the new structure allows us to operatively pool necessary force for larger project applications and also grant a great deal of independence to the scientific teams.

The scientific divisions are supported by two service units: 1) administrative and 2) technical support units, which are under direct supervision of the institute management.

Furthermore, in order to facilitate the project management, on March 15, 2015 the "Unit of project support" was established with aim to secure coordinated, with accordance to legislation carried out process of implementation of projects financed by EU structural funds, EU Framework Programmes and other development tools.

2) To build up laboratories equipped with the preparation techniques.

During the period of the last five years a number of laboratories has been established, built, equipped, and/or upgraded. Among them great attention has been paid to widening of the preparation capabilities. Besides the traditional metallography unit the Institute now operates several other laboratories for preparation of materials and specimens:

upgraded ceramography lab

fully equipped unit for preparation of transmission electron microscopy specimens

SEM-FIB lab (preparation of specimens in-situ, inside a scanning electron microscope equipped with focused ion beam)

whole range of labs for preparation of new materials: spark plasma sintering unit, powder

metallurgy - microwave sintering unit, lab of nanostructured materials (rapid solidification by melt spinning technique), nanotechnology lab (preparation of advanced nanofibers), etc.

3) To improve significantly the activities in the field of transfer of knowledge to the industry.

The transfer of knowledge has been a long time challenge for many academic institutions in Slovakia. Institute of Materials Research SAS participates in important Research centre of PROgressive MATerials and TECHnologies (PROMATECH) whose one of the principal aims is precisely to promote and facilitate the transfer of knowledge to industrial practice. As part of its activities, the Institute on November 11, 2015 established the Brokerage centre of IMR SAS as a platform for technological transfer.

The newly established Brokerage centre already organized several one-day workshops in the PROMATECH Centre premises for local scientific and industrial partners.

In years 2014 and 2015 the Institute initiated, co-organized and partly coordinated the Trans Tech Burza, a platform for meeting of academia and industry, for exchange of ideas and promotion of collaboration.

In order to promote the collaboration with industry the IMR SAS IMR entered into a cooperation agreement with Automation Technology and Robotics Cluster (AT+R, z.p.o., Košice), which includes important entities of local authorities, industrial companies, as well as academic institutions (e.g. universities). Its main task is cooperation in projects and activities of a developed network of laboratories and transfer of new technologies and applications of new materials - so called Advanced Materials (ie. Network AM) within AT+R cluster, z.p.o.

In the similar type of effort the IMR SAS began the collaboration with the National Technological Platform for Research, Development and Innovation (NTP VVIS). This effort culminated in 2015 by accepting IMR SAS as a regular member of NTP VVIS Association.

4) Special care should be given to use the new equipment effectively, both from point of view of managing them personally and finding some new attractive and useful research problems.

There has been a strong investment to infrastructure during the last decade. The Institute has acquired significant portion of new equipment, established and modernized a number of laboratories. The effective management of the new equipment is one of the most difficult challenges we currently face.

Under the new structure many of the mentioned laboratories are managed by the research teams that had the decisive role in their acquisition/equipment and have the strongest interest in using them. Even then, however, we feel very strong need for support from grant agencies, governmental and industrial entities interested in their use. We welcome and strive to use the new grant schemes and calls that enable to cover personal costs in more significant way. We would also support the facilitation and simplification of the rules for the use of research infrastructure for the purposes of industry and practice, so that the costs for using the equipment could be more easily earned from the contract research.

- **Supplementary information and/or comments on management, research infrastructure, and trends in personnel development**

3. Research strategy and future development of the institute for the next five years (2016-2020) (Recommended 3 pages, max. 5 pages)

3.1. Present state of the art in both the national and international contexts

a) Advanced metallic materials:
The main fields of interest in metallic systems are:

"*Advanced High Strength Steels for the Automotive Industry"* – the research is carried out with the aim to reduce the weight of auto bodies, the current goal is the development of ultra-high strength dual phase steel with emphasis on its good weldability, the easy application of protective Zn-coating, resistance to hydrogen embrittlement and increased toughness and fatigue resistance over previously developed materials. (Current project: VEGA 2/0176/15)
"Electro-technical steels for hybrid motors and electric vehicles" – the current challenge is the material development of newly-designed electro-technical steels exhibiting a suitable combination of mechanical and electromagnetic properties. The development trend of high-strength non-oriented electrical steel and technology involves reinforcing the solid solution by elements Si, Al, Mn and/or the reinforcing of partially recrystallized fine-grained ferrite using recrystallization hindering elements such as Nb, Ti, and V. The parallel task is to ensure technological treatability of electrical sheets by precise cutting. (Current projects: VEGA and APVV-15-0259 and APVV-14-0834)
"Creep-resistant steels and welds for highly-efficient thermal power plants" – the driving force of research and development is an effort to increase the efficiency of electricity production using high technology, energy-efficient pressure vessels. The research activities are aimed at studying the opportunities for increasing creep resistance of the newly developed creep resistant steels and their welded joints in long-term high-temperature conditions using thermodynamic calculations. (Current projects: VEGA 2/0151/16 and VEGA 2/0153/15)
"Nanocomposite materials on the basis of Mg alloys" – Mg alloys are attractive materials for lightweight structural applications. Improvement of their mechanical properties is possible by adding different (e.g. ceramic/carbon) nanotubes or nanoparticles and using methods of intensive plastic deformation (IPD). At present, research focuses mainly on the study of the formation of nanograins in the deformation process by ECAP. (Current project: VEGA 2/0118/14)
"Biodegradable alloys" – binary alloys Ca-Mg, Ca-Zn, Ca-Al, Ca-Cu, and the ternary alloys of type Ca-Mg-Zn and Mg-Ca-Cu have the lowest specific gravity (~ 2000 kg m^{-1}) among the known metallic glass types. Their modulus of elasticity (~ 20-35 GPa) is close to the values of the elasticity of human bones. In view of their potential use in medicine, it is very important that the systems of type Ca-Mg, Ca-Zn, Ca-Mg-Zn consist exclusively of biodegradable metals. (Current project: VEGA 2/0021/16)
"Nanocrystalline metallic systems prepared via powder metallurgy" – the dispersion reinforced composites with nanocrystalline Cu and Al based matrix with aluminum oxide nanoparticles promise high strength, thermally stable alloys with advantageous physical properties. The aim of the realized research is to prepare these materials by means of advanced powder metallurgy technology and their complex characterization. (Current project: VEGA 2/0021/16)
"New types of lead-free solders" – Development of the new types of lead-free couplings on a Sn basis with a higher share of intermetallic phases is a perspective for the requirements of realizing high quality joints for power electronics with excellent dependability and long life span in the conditions of thermo-mechanical stress. (Current project: APVV-14-0085)
"Metal-hydride alloys for effective hydrogen storage" – At the current development stage in the automobile industry, and the possible applications of hydrogen as a fuel, a key condition is for increasing the effectiveness of storage. The aim of current research is the proposal, preparation and comprehensive characterization of new metal hydride alloys mainly prepared through the method of rapid cooling. (Current project: APVV-15-0202)
"New types of thermoelectric alloys" – Thermo-electric materials are able to effectively transform surplus heat, or lost heat from industrial production, into a form of electrical energy. Research in this area will be conducted in the area of research and development of materials with complex metal or metal-oxide structure. We plan to realize this research with the support of the international projects upon invitation by 2020, ESA (European Space Agency) as well as M-ERA.NET.

b) Ceramic and non-metallic materials

At present the research in structural ceramics at IMR SAS is focused on new and modern multicomponent ceramic micro-composites but above all nano-composites, whereby combining micro- and nano-meter scale phases with very different properties it is possible to achieve significantly better performance, or control of it. There are mainly material systems based on the known nitrides, carbides, oxides and/or borides doped by a number of, often quite exotic, “alloying” additives, e.g. Hf, Lu, nano SiC, ZrO_2, but also by combination of traditional additives

like Si, C, B, etc. Very attractive and strongly emphasized are materials based on various carbon allotropes - from simple soot through graphene, graphene platelets, nanotubes, to amorphous (even tetragonal and H stabilized) diamond-like-carbon (DLC) for thin layers and coatings. Another direction is research of technology and properties of little known systems, e.g. HfB_2 ReB_2, SmB_6, B_6O, etc., which can be very interesting for ultra high temperature applications and/or have other functional properties. Until now these tasks were pursued in four main areas:

Bulk composite and nanocomposite ceramic materials with additives based on carbon allotropes (graphene, CNT, graphite, etc.);

Ceramic nanofibers for composite materials;

Dense and porous ceramic materials for biological applications;

Hard PVD coatings with controlled tribological properties prepared by pulsed ion sputtering.

The principal approach in all mentioned fields is the detailed study of relationships in the triangle of "technology - microstructure - properties", where recently, thanks to the acquisition of new equipment via the EU Structural Funds, there were significantly improved capabilities of technological preparation, of microstructure observation, and of measuring certain properties, mainly at the nano level. The scientific activities have been and are carried out in cooperation with IACH SAS Bratislava, TnUAD Trenčín, FMFI UK Bratislava, MTF STU Bratislava, TU Brno, ELTE Budapest, QMUL London, AGH UST Krakow, Polytechnika Lodzska, Lodz, MU Leoben, etc. One of the most important achievements is that in collaboration with the Institute of Technical Physics and Materials Sciences, Hungarian AS it was shown that, as one of the first in the world, carbon nanotubes can greatly increase the fracture toughness of silicon nitride. In the measurement of nanomechanical properties in WC, Si_3N_4 and B4C by pressure testing of micropillars and nanoindentation, real 3D maps of anisotropy of strength, hardness and elastic properties were made for the first time in the world. In the area of the superhard PVD coatings, the possibilities of HiTUS technique for improving hardness and consequently wear resistance in carbidic systems were identified.

c) Hybrid materials, biomaterials, functional materials

The research of functional hybrid materials was focused on modern multi-scale micro/nano powder composites. The preparation of such materials is often not possible without the application of progressive technologies of processing and compaction of powders like SPS, MWS, micro-MIM etc., while at ÚMV SAV work is done on the complex preparation and characterization SMC from laboratory preparation of coating powders, synthesis of ferrite nanoparticles through to compaction by conventional and progressive technologies, in addition the characterization of magnetic, electric and mechanical properties and their interpretation in the context of the inner structure of the composite. In this area we have long-term cooperation with UPJŠ Košice, ÚMCH AVČR Praha, ÚFM AVČR Brno and most recently with UPV Valencia Spain and IMS VAST Hanoi Vietnam.

Osteoarthritis as a non-inflammatory disease of the joints and spine affects 10-15% of the population, while the progressiveness rises at a higher age up to 50-80% and despite the excellently managed operating technique and mending the defect of the patient, on the surface of the defect there forms a biomechanically and physically less valuable cartilage, hence the defect is filled with material structurally and morphologically distinct from hyaline cartilage. The current problem of the wider use of biopolymers is the insufficient coverage of basic properties and structural characteristics of hyaline cartilage. In Slovakia at present there is no systematic research underway and the development of biomaterials oriented toward the resolution of chondral defects and general development of biomaterials for the reconstruction and regeneration of such tissue types and the the research is focused mainly on artificial joint replacements and the reconstruction of hard tissues. In the research of biomaterials the institute cooperates with the University of Veterinary Medicine and Pharmacy in Košice and the University of P.J.Šafárik in Košice.

The development of transparent thin films on the basis of lantanoids in the form of pyrochlore niobates and tantalates with ferroelastic properties represents a new direction of research. Prepared until now were thin films on the basis of lantanoids only by conventional alkoxide sol-gel method and the preparation of thin films on the basis of lantanoids from Nb and Ta salts synthesized by polymer complex sol-gel method is a great challenge, for it concerns a relatively new type of synthesis at modified conditions with the consequent determination of

mechanical properties by nanoindentation. The essense will be to study the structural and mechanical properties of materials following their phase polymorphism from the standpoint of their possible application as solid electrolytes in the electro-technical industry.

3.2. Research strategy of the institute in the national and the international contexts, objectives and methods

a) Advanced metallic materials

In the area of *"Advanced High Strength Steels for Automotive Industry"* shall be realized the development of ultra-high strength silicone-free low carbon dual-phase steels with a high resistance against hydrogen embrittlement. The degradation effect of hydrogen, development of local deformations and plastic zones before the face of initiated cracks will be assessed on the samples with concentrator pressure. Part of the research will be the development of new testing methods focused on the study of local properties of the materials.

In the area of *"Electro-technical steels for hybrid motors and electric vehicles"* there shall be proposed and analyzed a new conception of design of microstructures and substructures of high strength isotropic electro-technical steels, ensuring a combination of high strength and excellent electromagnetic properties for use when constructing rotor cores in electromobiles for hybrid drive automobiles. The research strategy will hinge upon knowledge of the evolution and kinetics of structure-creating processes in electro-technical steels in the conditions of thermal-deformation activation.

In the area of *"Creep-resistant steels and welds for high-efficient thermal power plants"* research shall be focused on the development of a new generation of creep-resistant steels alloyed with boron, their welding and technological processing for the purpose of increasing creep strength and resistance to brittle cracking in conditions of degradation. From a methodological standpoint innovative approaches will be employed of thermophysical simulation and structural-fractographic analysis.

In the area of *"Thermodynamic modelling of alloy systems"* we plan to focus on expanding the database for thermodynamic calculations useable for complex steel alloys.

In the area of *"Non-ferrous materials"* a noteworthy activity is the development of *"Nanocomposite materials on the base of Mg alloys",* where in cooperation with NTU Taipei, Taiwan we will share in the research and development of new nanomaterial systems on the base of Mg prepared by the method of intensive plastic deformations and reinforced nanoparticles Al_2O_3, SiC and carbon nanotubes.

Further key courses of interest are seen in *"Biodegradable alloys", "Nanocrystalline metallic systems prepared via powder metallurgy", "New types of led-free solders", "Metal-hydride alloys for effective hydrogen storage", and "New types of thermoelectric alloys".* In these fields of endeavour we plan to develop our cooperation with both domestic and foreign partners. From among the domestic, this would be mainly with the Technical University in Košice, University of Pavol Jozef Šafárik in Košice, Institute of experimental physics SAV and the Institute of materials and machine mechanics SAV. Furthermore, to develop cooperation with partners abroad such as EMPA Thun Switzerland, TU Braunschweig Germany, Politechnika Warszawska Poland, Innovation Center Iceland, Iceland and others. And then also to continue applying for measuring projects at international research centers such as: DESY Hamburg Germany, ESRF Grenoble France, ILL Grenoble France and others.

b) Ceramic and non-metallic materials

According to predictions in material research, world expectations include strengthening of the role of nanomaterials including graphenes, strong activities in the ultra high temperature materials, materials for biological applications, for power and machine engineering with the aim to reduce energy consuption, power losses, to increase the energy storage and transformation efficiency in power and machine engineering applications. This will require research of new types of materials with special microstructure, mainly “nano” ones, materials with nonstarndard composition, e.g. based on rare earth elements and high temperature elements for ultra high temperature applications, multi-component materials combining very different and often

contradictory properties such as hardness and fracture toughness, or low friction with high oxidation resistance, materials with large active surfaces for various catalytic and biological applications.
This vision is in accordance with global needs and at the same time it assumes that there will be maintained and developed the main principles of a qualitative approach to resolving the tasks of research and development in conjunction with further infrastructure and personnel development in the second round of projects financed by the Structural Funds.
Development in strategical directions will require intense research of the above mentioned material types. The needs in these fields require the strengthening of technological and analytical capabilities as well as those of measurement of the corresponding spectrum of material properties. For completion of the infrastructure of SPS technologies, there has to be completion by particular technology nodes of preparation and control of powders, in iPVD technologies equipment for the deposition of multicomponent coatings is required, as well as expansion of the power envelope of the pulse sources. Nano-spiders will benefit from the supplement of preparation and characterization of polymer precursors and post-processing. Analyses have to be complemented with the following techniques: XPS, SIMS, RTG microscope with in-situ loading, analytical HR FE SEM and TEM with a standard cathode, including foil preparation capacity. Mechanical testing should be complemented with a residual stresses measuring device, high temperature vacuum tribometer, and optical profiler. Upgrading and refurbishemnt of the mechanical workshop is desirable as well.

c) Hybrid materials, biomaterials, functional materials
The strategic intention in the area of powder metallurgy and functioning composite materials is an orientation toward research and development of swage-free technologies of compaction of powder materials, the so-called „Additive manufacturing“(AM). At the same time it is a great opportunity for applying powder technologies in the areas of low-serial production. On the other hand, industrial application is hindered by the limited number of available powder alloys, for which the AM producers provide a guarantee of applicability. We plan research in this area to be focused upon analyzing the applicability of amorphous, nanocrystalline alloys and alloys with a high extent of chaotic structure and possibilities for their processing by AM methods in connection to their physical and mechanical properties.
In the area of PM there will be a continuation of research and characterization of biologically biodegradable materials prepared from powder metals, while attention will be concentrated on the material types with coatings of bioceramic/biopolymer deposited on the surface of the metals biomaterials, in which the corrosion, biocompatibility and change in mechanical properties during corrosion are not completely understood or satisfactorily described. Study of the biologically degradeable alloys of iron and magnesium prepared by powder metallurgy brings forth new knowledge as to the fundamental processes taking place during corrosion and about the dependance of mechanical properties from the degree of material degradation, which subsequently enables optimalization of the composition of the entry raw materials, production process and suitable coating and select the course of changes of mechanical properties during the material degradation.
The research and development of chondral implants must be concentrated on the preparation of composite implants and structurally differentiated biopolymer layers with differing porosity and orientation of tissues, the most suitable created by 3D print of hydrogels, or systems stimulating the differentiation of stem cells into chondogenic lines at the location of the defect. The essense will be acquiring implants of morphologically similar structure as the cartilage has, or composites with a similar physical-chemical character allowing the material to be actively engaged in the process of healing and the creation of new cartilage tissue. In the area of biocements it will be necessary to be oriented on research of hydrogel/calcium phosphate biocements enabling the biomimetic precipitation of cacium phosphates with specific orientation of the particles, which influences the strength of the interface, microstructure and properties of the cement composites.The resulting system will mimic the composition of bone tissue and resemble the ossification processes of creating bone tissue by means of hydrogel component.

Although the coexistence of ferroelectricity and ferromagnetism in the rare-earth substituted $BiFeO_3$ ceramics was observed at room temperature, a long-range ferroelectric order was found to be suppressed due to dilution of Bi 6s2 lone pairs by rare-earth doping. The future research activities in the field of multiferroic materials will be, therefore, focused on the design, synthesis

and characterization of alternative Aurivillius phase multiferroics, in which magnetic atoms incorporated into a bismuth-layered structure contribute to both the ferroelectric polarization and the magnetization at the same time. Specific device applications that have been suggested for such materials include multi-state digital memory (RAM) elements, electric-field-controlled ferromagnetic resonance devices, and transducers with magnetically modulated piezoelectricity.

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 period 2016-2020 preserved and also developed in quality, connected to further development of infrastructure and means of the EU Structural funds and for the development of personnel and staffing.

From the viewpoint of staff development, effective measures must be undertaken at once, incorporating:

Marked increasing the level of financial remuneration of executive personnel and differentiation in the remuneration of workers. Required for this is stable financing fully ensuring the payroll from institutional sources;

Increasing the number of employees so that each specialized piece of equipment or facility has at least two persons assigned to it;

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 with a significantly higher extent of funding than in national projects.

We shall work on strengthening the position of IMR SAS to a European-wide standard by being engaged in European international projects Horizont 2020, as well as collaboration focused upon research of living and non-living nature.

Project proposals submited to 7RP or H2020	2012	2013	2014	2015
Institute as coordinator	0	0	0	0
Institute as participant	3	2	5	5

4. Other information relevant for the assessment

Košice 3.8.2016

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