## PROJECTS OF THE INSTITUTE OF MATERIALS SCIENCE

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| **Project Title** | **Quantification of radiation damage in composite materials for thermonuclear fusion reactors** |
| Coordinator | doc. Ing. Mária Dománková, PhD. |
| Start Date | 01/01/2013 |
| End Date | 31/12/2016 |
| Program | VEGA |
| Annotation | One of the most important criteria which have to be met by materials for construction of thermonuclear fusion reactors is resistance against irradiation. Collisions of high-energy particles with the reactor containment causes defects in substructure of the construction materials. To evaluate suitability of the construction materials it is essential to compare substructure of reactor wall before and after simulated radiation damage. Systematic analysis of defects will be performed by combination of macroscopic, microscopic, submicroscopic and spectroscopic methods, which will reveal changes in substructure and chemical composition of materials on the surface as well as inside of samples. |

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| **Project Title** | **Investigation of metallurgical principles of changes in microstructure and properties of Cr-V ledeburitic steel due to sub-zero treatment** |
| Coordinator | prof. Ing. Peter Jurči, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2016 |
| Program | VEGA |
| Annotation | The project is focused to the investigation of phenomena taking place in selected chromium-vanadium ledeburitic tool steel when it is sub-zero treated using various regimes of the treatment. The effects of important heat treatment variables such as the austenitizing temperature, tempering regimes and hold at the temperature of sub-zero treatment on the microstructure, the hardness, the three point bending strength, the fracture toughness and the wear resistance will be determined. In the project, variety of investigation techniques are planned to be utilized, which makes it possible to achieve the main goal of the project - to make a serious and comprehensive analysis what happens in the microstructure of selected Cr-V ledeburitic steel when sub-zero treated using various regimes and, what is an impact of microstructural changes on mechanical properties and tribological performance of the material. |

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| **Project Title** | **Corrosion stability of advanced zinc, aluminium and tin alloys** |
| Coordinator | Mgr. Marián Palcút, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2017 |
| Program | VEGA |
| Annotation | The goal of this project is to investigate the corrosion stability of phases in Zn, Al and Sn alloys. The studied materials can be used, for example, as light materials for automotive and aviation industries, steel protection coatings or lead-free solders for microelectronics. The alloys shall be prepared by a controlled melting of pure elements. The corrosion resistance will be studied in aqueous electrolytes. Moreover, the alloys stability shall be investigated in simulated off-shore conditions by a salt spray test. Selected samples will undergo a high temperature oxidation testing in corrosive atmospheres. Furthermore, mechanical properties will be investigated and a stress corrosion cracking behaviour shall be characterized. The oxidation products will be studied by a combination of methods, including X-ray diffraction, energy dispersive spectroscopy, transmission electron microscopy and infrared spectroscopy. The aim of the project is to identify corrosion resistant alloys for practical applications. |

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| **Project Title** | **Application of complex thermal analysis and computational thermodynamics at investigation of processes in advanced materials systems** |
| Coordinator | doc. Ing. Roman Čička, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2017 |
| Program | VEGA |
| Annotation | The project is focused on application of experimental and computational thermodynamics at the investigation of processes and phase equilibria in selected materials systems as complex metallic alloys, advanced tool steels, austenitic stainless steels, hardenable aluminium alloys and lead-free solders. In experimental part the complex thermal analysis of investigated systems will be performed, together with the measurement of some important thermophysical properties and analysis of structure. In computational part the phase quilibria and processes occuring in the investigated materials during controlled temperature programme will be modeled using Thermo-Calc, JMatPro, Dictra, ANSYS, SYSWELD, DEFORM and MATLAB software. The aim of the project is to improve the prediction of phase equilibria and processes in materials systems, using advanced techniques of computational thermodynamics. |

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| **Project Title** | **Multicomponent special glasses for optoelectronics, non-linear optics and fiber optics** |
| Coordinator | doc. RNDr. Vladimír Labaš, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2016 |
| Program | VEGA |
| Annotation | The project is oriented on special glasses and glasses doped by are-earthelements for applications in optoelectronics, fiber optics and non-linearoptics. In case of chalcogenide glasses and heavy metal oxide glasses, we will investigate relations between their composition and preparation technology, glasses structure and their physical properties, which determine the suitability of glasses for practical applications too. The modeling of studied processes, structural or electronic defects, and optical centers will be added. We will develop methods how to use our physical measurements for determination of basic characteristics of glasses (thermal, chemical stability, occurrence of crystalline phases, phase separation, bulk homogenity etc.). |

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| **Project Title** | **Preparation and characterization of the properties of new types of hard coatings for tool materials** |
| Coordinator | prof. Ing. Ľubomír Čaplovič, PhD. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2018 |
| Program | VEGA |
| Annotation | The submitted project is aimed on development of new type superhard coatings for tool materials with enhanced useful properties. The project is based on gathered knowledge about correlation of structural and stress relations in hard and superhard nitride coatings of transition metals in monolayer or multilayer system on in advanced prepared surface of substrate which is basically tool steel or cemented carbide. By application of two technological processes of creating functional coatings (cathodic arc evaporation and magnetron sputtering),deposition process and its effects of doping of additional interstitial elements (boron, carbon) will be analyzed as well as substitutional elements such as aluminium and silicon in order to achieve a nanocomposite morphology of these coatings. |

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| **Project Title** | **Preparation and characterization TiC nanocomposite coatings by HiPIMS method for automotive applications** |
| Coordinator | prof. Ing. Ján Lokaj, CSc. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2017 |
| Program | VEGA |
| Annotation | This project focuses on the investigation of plasma parameters and the deposition behaviour of HiPIMS process with pre-ionization. Thus, the aim of this project is to perform diagnostics of the plasma generated by powerful pulses with pre-ionization in order to understand the relationship between the process parameters and local parameters of deposition plasma, which actually govern plasma processes and plasma-surface interaction. The aim of this project is also to prepare and characterize nanocomposite TiC wear-resistant coatings targeted for automotive applications where high load-bearing capacity and thermal stability, low friction, and wear resistance are the primary requirements. |

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| **Project Title** | **Implementation of non-destructive methods for the description of the physical characteristics of advanced thin-layered materials** |
| Coordinator | Mgr. Ondrej Bošák, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2016 |
| Program | KEGA |
| Annotation | The project is oriented on the improvement of possibilities of the on-destructive diagnostics of materials based on thin layers. Content of the project supports the development of educational and scientific research activities in the field of ion and plasma technology in Faculty of Material Science and Technology in Trnava. The aim of the project is to prepare and implement another experimental methods of materials investigation, which will increase the competence of graduates of all levels in the field of materials and at the same time to extend the current capabilities of the scientific research activities aimed at the study of selected physical parameters by non-destructive methods. |

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| **Project title:** | **Analysis of structural changes and characterization of electric properties of special glasses designed for optoelectronic applications** |
| Coordinator: | doc. Ing. Mária Dománková, PhD. |
| Start date: | 01/01/2016 |
| End date: | 31/12/2017 |
| Programme: | APVV |
| Annotation: | The project is orientated on the support of cooperation between Slovak and French partners in the field of study of structure and physical properties of a new special glasses systems based on chalcogenides and heavy metals oxides with a higher content of ionic bonds. From the professional point of view it is the study of changes in the glass structure generated by the change of chemical composition, investigation of the preparation technology and effect of increased temperature and humidity. Changes in structure usually affect formation of a new phases, which can be monitored using electrical and optical methods. The project will provide extension of the cooperation at preparation of common outputs and publications oriented on diagnosing of special glasses designed for optoelectronic applications, possibly for solid electrolytes. The aim of the project is a detailed description of the structure and properties of glasses enhanced by the results of the analysis of electrical and dielectric parameters. |

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| **Project title:** | **Research of the coating/ substrate interphase modification to increase hard coating adhesion** |
| Coordinator: | prof. Ing. Ľubomír Čaplovič, PhD. |
| Start date: | 01/07/2016 |
| End date: | 30/06/2019 |
| Programme: | APVV |
| Annotation: | In the last decade, hard coatings based on nitrides or carbonitrides of transition metals play significant role in increasing the lifetime of the cutting and forming tools, but also in specific products of mobile devices. The main requirement for this type of material is high hardness and abrasion resistance. However, in the case of dynamic leading and frequent alternation of heat cycles, the adhesion of the coating to the substrate is the decisive factor. The object is just focused to this area with the main aim to find and optimize physical processes to enhance the adhesion ability of selected types of coatings and create a mathematical model that could describe the physical processes involved. The specific goal is to verify the influence of the initial state of the substrate surface prior to the coatings deposition both in terms of structural,thermal and deformation characteristics of the coatingsubstrate phase interface. Different methods for cleaning of substrates, surface exposition and deposition technologies will be utilized for these tasks. The techniques of plasma, magnetron and ion sputtering as well as cathodic arc evaporation will be mainly used. The experimental methods such as electron microscopy, X-ray diffraction analysis. Auger electron spectroscopy and optical emission spectroscopy as well as a special ion beam/ matter interaction based techniques (RBS, PIXE) will be utilized for the study and explanation of processes that could occur at the coating/ substrate phase interface. The method of FEM will be used for the clarification of effects of both internal and residual stresses to the coating/ substrate interface character. The output will be a comprehensive analysis of the influence of individual parameters of used processes on increasing of interface adhesion and drafting the proposals for their applications in the preparation of hard coatings with enhanced exploitative properties. |

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| **Project title:** | **Advanced materials, processing and automation technologies** |
| Coordinator: | doc. Ing. Martin Kusý, PhD. |
| Start date: | 2011 |
| End date: | 2018 |
| Programme: | NV Bekaert SA |
| Annotation: | The subject of the research will be Research of advanced materials, processing and automation technologies for direct manufacturing and application. The aim of the project is to bridge basic and applied research in the field of advanced materials with application and manufacturing leading to competitiveness and sustainable growth of both partners. A valuable and unique aspect of the research project is broad involvement of students of master and doctoral degree in up-to-date research activities. |

## PROJECTS OF THE INSTITUTE OF PRODUCTION TECHNOLOGIES

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| **Project Title** | **Research of modified solders for fluxless soldering of metallic and ceramic materials** |
| Coordinator | prof. Ing. Roman Koleňák, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2016 |
| Program | VEGA |
| Annotation | Project is aimed at research of modified soldering alloys. This concerns mainly the research of soldering alloys type Sn-Ag-Ti, Sn-Ag-Cu and Zn-Ag-Al. New soldering alloys, alloyed with a small amount of active elements (In, Ga, Y and several |

components from the group of lanthanides) will be prepared for experiments. The solders will be designed with the aim to apply in fluxless soldering by use of laser and power ultrasound technologies. The tests of technological solderability of ceramic and metallic materials will be performed with use of modified soldering alloys. The character of solder structure and quality of soldered joints will be studied at different soldering conditions. Also interactions on the boundary of soldered material and solder will be investigated.

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| **Project Title** | **Utilization of modern optical 3D scanning methods for weldment deformation analysis** |
| Coordinator | prof. Ing. Milan Marônek, CSc. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2016 |
| Program | VEGA |
| Annotation | Today's methods of weldment deformation measurement utilize, particularly from economical reasons, simple measurements instruments for distance and angle measuring, whereas they are provided by a human operator. If the weldment construction is complicated and requires a large number of measurements, the whole process is also time consuming. It is obvious, the results are also influenced by a human factor. The modern 3D scanning methods being applied apart from architecture, civil and reverse engineering, are more and more often used in the field of production technologies, e. g. in an automotive industry. The goal of the submitted project is to evaluate the applicability of 3D scanning methods in measurement of deformations originated from welding. The influence of scanning method and scanning parameters on final measurement accuracy, scanning methods suitability with regard to weldment size, used welding technology and its process parameters will be investigated in the project research. |

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| **Project Title** | **Research of influence of selected characteristics of machining process on achieved quality of machined surface and problem free assembly using high Technologies.** |
| Coordinator | doc. Ing. Peter Pokorný, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2017 |
| Program | VEGA |
| Annotation | The project is focused on research of selected characteristics of machining process (cutting forces, thin walled parts machining, tool wear and tool renewing, cutting fluids and machining strategies). Characteristics of machining process affect the quality of achieved surface. The project uses high Technologies, which are situated in centre of excellence of 5 axis machinig (high speed milling machine tools, ultrasonic milling tool, laser milling tool, tool grinder). On the geometric and dimensional accuracy depends the condition of assembly or more precise, the result of assembly process. Therefore the methodology will be designed in order to adjust machining technology with demands of geometric specification of parts. |

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| **Project Title** | **Research of defect diagnostic of welded joint by using of modern NDT methods** |
| Coordinator | prof. Ing. Koloman Ulrich, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2016 |
| Program | VEGA |
| Annotation | The project aim is the research of defect diagnostic of welded joints using modern ultrasonic methods TOFD and Phased Array (PA) compared with radiation methods and impact of defects detected on the lifetime of welded structures. Samples of welded joints shall be prepared with artificially created defects, to be used to verify |

the sensitivity of UT techniques and results of detected defects will be compared with classical and modern radiation methods. Methods TOFD and PA will be further applied to measurements in industrial practice for testing of welded joints of concrete.

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| **Project Title** | **Establishing the patterns of the structure and properties formation in high-speed steels during melting and casting in vacuum** |
| Coordinator | prof. Ing. Alexander Čaus, DrSc. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2018 |
| Program | VEGA |
| Annotation | With proper choice of an appropriate nomenclature the durability of cast cutting tools (CCT) can be better than that of conventional tools. However, for successful application of CCT it is necessary to provide adequate impact toughness of cast high speed steel (HSS). From this point of view casting into metal moulds is more attractive because due to high rate of solidification this technology provides enhanced alloy density, fine-grained cast structure, consequently enhanced mechanical properties, primarily impact toughness. Disadvantage is the low life of moulds when casting HSS. |

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| **Project Title** | **Research of laser surface texturing and its application in the sheet metal forming processes tribological conditions optimization** |
| Coordinator | prof. Ing. Peter Šugár, PhD. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2018 |
| Program | VEGA |
| Annotation | The project is aimed at the research of the laser texuring of metal spinning tools. Two fields of interest are solved in this project. The goal is optimization of rolling friction conditions in the contact area spinning tool -- formed part with minimal quantity of lubricants and creation of assumptions for improvement of the spun part surface quality while reducing the intensity of tool wear and unwanted adhesion sticks formation. |

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| **Project Title** | **Research of deformation processes using spatial reconstruction of microstructure and shape of formed parts.** |
| Coordinator | prof. Ing. Maroš Martinkovič, PhD. |
| Start Date | 01/01/2016 |
| End Date | 31/12/2019 |
| Program | VEGA |
| Annotation | Final properties of forming metal parts are affected by production technological processes. Due to forming not only shape of body is changing, but so as structure anisotropy is increased-- grain boundaries orientation in various places of piece. Research, development and application of stereology methods of statistic reconstruction of three-dimensional plastic deformed metal material structure in examining the dimensional changes forming body using industrial computed tomography and coordinate measuring machine. Utilization of this results to a detailedlead analysis of material structure changes, resulting properties and consequential technological processes optimization and knowing quantitative dependences "technological parameters - microstructure -- properties". |

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| **Project Title** | **Development of a virtual laboratory for Robotics and Manipulation techniques** |
| Coordinator | prof.h.c. prof. Ing. Karol Velíšek, CSc. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2016 |
| Program | KEGA |
| Annotation | The main aim of the project is the establishment of laboratory with the group of training modules from the area of automation and industrial robotics, which will serve the several purposes. Namely training of automatic control of handling equipment and programming of industrial robots, which are nowadays increasingly implemented into manufacturing practice. This laboratory will enable to develop students' knowledge and practical skills in the area of automated and robotic systems applying the innovative educational program and methodology which use modern IT technologies, e-learning including. The aim is also an elaboration of study materials with widely applicable exercises, that can make the laboratory study more effective and can serve the further knowledge and skills. |

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| **Project Title** | **Blended Learning principles implementation into teaching of programming of CNC machine tools with advanced kinematic structure** |
| Coordinator | prof. Ing. Peter Šugár, CSc. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2016 |
| Program | KEGA |
| Annotation | The project is focused into unification of teaching methods of programing CNC machine tools and machinery with different structures and technological purposes, with emphasis on machine tools and machinery with advanced kinematic structure, using Blended Learning principles. Students of all levels of university education, postgraduate education and also partially students of secondary technical schools are the education recipients. |

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| **Project Title** | **Research of electron beam complex generation designed to vacuum welding of aluminum and magnesium alloys** |
| Coordinator | prof. Ing. Koloman Ulrich, PhD. |
| Start Date | 01/07/2015 |
| End Date | 30/06/2018 |
| Program | STIMULY Req-00048-0005 |
| Annotation | The strategic objective of the industrial (applied) research and experimental development project is an overall increase of technical parameters the critical modules of electron beam welding technology complexes comparable to world level. |

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| **Project title:** | **Research of weld joints properties of duplex and superduplex steels** |
| Coordinator: | prof. Ing. Koloman Ulrich, PhD. |
| Start date: | 01/10/2013 |
| End date: | 31/12/2016 |
| Programme: | APVV |
| Annotation: | Project is focused on basic research of conditions and procedures of creating the weld joints by laser and electron beam on selected types of duplex stainless steels with ferritic-austenitic structure. Concentrated energy sources, due to their flexibility allow immediate applicaton of preheating before the welding process and post-heating after the welding process using a defocused or rasterized beam, what provides a great research potential. The weldability of duplex and superduplex steels, the structural analysis and the tests of mechnical properties as well as corrosion properties will be investigated in particular stages of the project. All processes of technological network participate on final properties of the product. That is why the experimental research program will also cover analysis of weld joints created from materials influenced by different type and level of deformation as well as the sheet |

forming of weld joints. Special focus will be devoted to finding the correlation between the crucial technological parameters of the process and properties of performed weld joint. The project has the ambition to push the knowledge boundaries of the welding process of selected duplex stainless steels by the concentrated energy sources, such as laser and electron beam.

**Project title:** **Research of new soldering alloys for fluxless soldering with application of beam technologies and ultrasound**

Coordinator: prof. Ing. Roman Koleňák, PhD.
Start date: 01/10/2013
End date: 31/05/2017
Programme: APVV
Annotation: The project is oriented toward the research of environmentally friendly solder alloys and conditions of soldering with progressive technologies. The designed and experimentally manufactured solders will be used for soldering of metallic and ceramic materials at higher application temperatures. For assuring the wettability of ceramic and hard-to-solder materials, the solders will be alloyed with active elements and the metals from the group of lanthanides. The tests of technological solderability of ceramic and metallic materials will be performed by use of new soldering alloys at flux-free soldering, with application of laser technologies, power ultrasound and electron beam. The structural charakteristics of solders and soldered joins will be studied at different soldering conditions.

**Project title:** **Development of new multicomponent environmentally- friendly lead-free solder for low-cost electronic assembly**

Coordinator: doc. Ing. Erika Hodúlová, PhD.
Start date: 01/01/2016
End date: 31/12/2017
Programme: APVV
Annotation: The project aims at developing and manufacturing complex multiphase materials free of toxic elements content, with enhanced mechanical properties and moderate costs compared to commonly used zero-Pb solder alloys. Preference is given to metal matrix composites, Sn-, Cuand Ag-based alloy systems with the small addition of In and Bi. Implementation is focused on sustainability, where an environmental advantage will be leveraged through the utilization of cheap, non-toxic raw materials by advanced recovery methods. To date, the most widespread Pb-free replacements for lead-bearing solders are binary alloy systems for high-temp service environments Sn-Ag-Cu baseline alloys, the application of which poses a number of technical problems. Inferior tensile behaviour, poor creep resistance, low conductivity and high melting temperature mostly yields narrow process window, soldering failures and weak life cycle performance. Cost aspect and the compensatory addition of critical elements are the prime challenges to face.

**Project title:** **Challenges in joining of titanium alloys**

Coordinator: doc. Ing. Erika Hodúlová, PhD.
Start date: 01/01/2016
End date: 31/12/2017
Programme: APVV
Annotation: Joing is literally where all parts of the manufacturing process come together, and thus joing processes are essential to virtually any manufactured product. In particular, joing of titanium alloys is of paramount importance for the aeronautic, aerospace, automobile and biomedical industries. Accordingly, the main objective of the project under proposal is to develop new strategies to join Ti alloys to themselves and to other alloys. Similar and dissimilar joints will be processed by fluxless

soldering using beam technologies and power ultrasound. Reactive multilayers will be used to enhance the joining process. These multilayers will act as highly localizated heat sources. The advantage of using reactive multilayers as filler material will be evaluated. The joints processed will be (micro)structurally and mechanically characterized in order to identify for each case the most adequate joining process and the most promising filler materials.

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| **Project title:** | **Research on welding of progressive light alloys by beam welding methods** |
| Coordinator: | prof. Ing. Milan Marônek, CSc. |
| Start date: | 01/07/2016 |
| End date: | 31/12/2019 |
| Programme: | APVV |
| Annotation: | The major objective of the project is to bring a new knowledge in the field of welding Ti and Al-Li alloys by laser and electron beam welding methods. These advanced alloys have perspective of their further exploitation also in other industrial areas, where weight reduction and corrosion resistance is required. Nowadays, beam welding methods are used in mass production even more frequently, because of their high productivity and minimal degradation effects on welded materials. However, the knowledge about beam welding of these alloys significantly absents. |

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| **Project title:** | **Research of technological process of forming at production of tubes with contoured internal surface** |
| Coordinator: | prof. Ing. Maroš Martinkovič, PhD. |
| Start date: | 01/07/2016 |
| End date: | 30/06/2020 |
| Programme: | APVV |
| Annotation: | It is necessary to pay close attention to the research of deformation processes regarding the production of seamless cold drawn tubes, whether precision tubes or tubes with contoured internal surface for industrial purposes. Rationalization of production requires to analyze state of stress and deformation at different methods of tube drawing (drawing on a cylindrical plug, drawing on a floating plug, drawing on a rod, drawing by die move - without plug), with special attention to the question of possible development of finished products (precision tubes) by increasing the intensity of industrial moves ( maximum reduction) as well as the feasibility of multistage drawing (i.e. incremental forming) without inter-annealing. Microstructural analysis will be used for plastic deformation of individual moves in the tube volume, the analysis of limit plasticity state, when drawing of tubes tends to increase the dislocation density up to its critical level, which represents immobility of dislocation, i.e. termination of the material deformability with subsequent damage (rupture) of material. Experimental processes will be numerically simulated in a virtual environment of DEFORM 3D program, numerical models will be verified by comparison with experimental results of microstructural analysis and dimensional analysis using computer tomography, Consequently the research results will be verified in practice. |

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| **Project title:** | **Innovative methods of sheet metal forming tools surfaces improvement - R&D** |
| Coordinator: | prof. Ing. Peter Šugár, PhD. |
| Start date: | 2015 |
| End date: | 2017 |
| Programme: | FormTool MANUNET-2014-11283 |
| Annotation: | The project is focused on developement and verifying a new advanced technology of sheet-metal forming tools surfaces improvement in order to obtain better performances, lower costs and lower environmental impacts of sheet-metal parts production processes. The attention is paid to issue of stamping and metal spinning |

tools and its application in metal forming processes of different challenging materials, such as Al-alloy, Mg-alloy, Ni-alloy, duplex and super-duplex stainless steels. It aims to demonstrate the technical, economical and environmental feasibility of advanced forming tool surfaces treatment by laser micro-structuring (texturing) and hydrostatic ball-burnishing applied to improve the stability of forming processes.

## PROJECTS OF THE INSTITUTE OF INDUSTRIAL ENGINEERING AND MANAGEMENT

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| **Project Title** | **The Model of the implementation of controlling as a management tool within medium enterprises in the engineering and electronics industries** |
| Coordinator | prof. Ing. Dušan Baran, PhD. |
| Start Date | 01/01/2016 |
| End Date | 31/12/2018 |
| Program | VEGA |
| Annotation | The research project deals with the current and very important problems of the research and application of advanced control methods in terms of economic sciences. The project analyses the current state of implementation of modern management methods in Slovakia and abroad, especially in the EU and the U.S., with a focus on medium-sized enterprises. The project assesses the internal and external conditions that implementation. Formulates the basis for the creation of scientific foundations subsystem and controlling instruments (subject, basic concepts, explanations and definitions examination). Based on this analysis project defines and develops the already used methods , tools , resources , forms , models and management techniques in the conditions of market economy . At the same time project proposes a unified model subsystem implementation and controlling instruments in the business community, focusing on a group of medium-sized enterprises. |

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| **Project Title** | **An innovative approach to legislative coordination of environmental protection through the visualization on the basis of the phenomenon Small World Networks** |
| Coordinator | doc. Ing. Alena Pauliková, PhD. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2017 |
| Program | KEGA |
| Annotation | The purpose of this project is to develop a comprehensive review and subsequent coordination of environmental legislation as part of a system of ambient protection. Selected set of laws which form part of the environmental legislation will include laws, regulations, decrees, international treaties and agreements and other relevant provisions of the national character. Coordination will be done using hierarchical organizational charts and finally visualized using Small World Networks |

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| **Project Title** | **The research of Games Learning applications impact into the educational process effectiveness in newly accredited study course: Fundamentals of Industrial Engineering** |
| Coordinator | Ing. Vanessa Prajová, PhD. |
| Start Date | 08/07/2015 |
| End Date | 30/04/2016 |
| Program | Nadácia Volkswagen Slovakia |
| Annotation | Project is focused on the application of new, creative methods and forms of university |

level education within the selected study course: Fundamentals of Industrial Engineering and multiplicative transfer of this knowledge to following study courses.

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| **Project title:** | **Social Innovation for Youth Social Entrepreneurship (INNOVAT)** |
| Coordinator: | doc. Mgr. Dagmar Cagáňová, PhD. |
| Start date: | 2015 |
| End date: | 2017 |
| Programme: | ERASMUS+ |
| Annotation: | InnovaT wants to strengthen the capabilities of 7 social organisations that work in the field of youth: 4 from Europe (Spain, Portugal, Greece and Romania) and three from Latinamerica (Nicaragua, Colombia and El Salvador) in order to improve their work in the YOUTH PARTICIPATION SECTOR and specifically working in 3 KNOWLEDGE AREAS: Methodologies for social innovation ICTs tools Social entrepreneurship and communitarian development This project wants to contribute in the implementation of "Europe 2020" strategy, working specifically in the fights against poverty and social exclusion of youth. |

## PROJECTS OF THE INSTITUTE OF INTEGRATED SAFETY

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| **Project Title** | **Studying the use of advance oxidative processes for metalworking fluids lifetime extension and for their following acceleration of biological disposal at the end of the life cycle** |
| Coordinator | prof. Ing. Maroš Soldán, PhD. |
| Start Date | 01/01/2014 |
| End Date | 31/12/2017 |
| Program | VEGA |
| Annotation | Project follows the possibility of using low concentrations of O3 as a progressive method of hygienisation of MWFs during the period of their use in machining. It is for the purpose of extending the lifetime of MWFs, protection of the human operator of the machine by the reducing the amount of biocide used and reducing of used sources by their longer utilizing (economic, environmental and safety aspects). On the other hand, after the useful life of process fluids on the machine will be monitored the effect of high concentration of O3 (with the combination of other advanced oxidative processes mostly sonolysis and photocatalytical oxidative processes) to accelerating biodegradation of MWFs (economic and environmental aspects). The decrease of organic substances content as well as the primary elimination of biocides will help to biological degradation of this type of waste. Both aims reflect to the world trend of sustainability, decreasing substances toxicity and increasing of biological treatment of wastes. |

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| **Project Title** | **The readiness of industrial enterprises to implement the requirements of standards for quality management systems ISO 9001:2015 and environmental management systems ISO 14001:2014** |
| Coordinator | doc. RNDr. Miroslav Rusko, PhD. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2017 |
| Program | VEGA |
| Annotation | The project is focused on the research and analysis of current approaches to quality management system and environment with respect to readiness to implement the changes induced by formation of SL Annexes to Regulation ISO / EIC "Consolidated Supplement - Procedures specific to ISO", and in particular the requirements into a single structure standards for management systems. Based on the analysis methodology will be created for successful transformation of new approaches to |

quality management and environmental management as defined in forthcomming revisions of the standards. Besides, the methodology for effective implementation of defined standards requirements will be developed.

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| **Project Title** | **Creation of high schoolbooks for study programmes Fire protection and safety and Integrated safety** |
| Coordinator | prof. Ing. Karol Balog, PhD. |
| Start Date | 01/01/2016 |
| End Date | 31/12/2018 |
| Program | KEGA |
| Annotation | The common creation of multimedia university schoolbook by teachers from the universities providing education in related study branches rescue services and labour safety will provide the education enhancement of high-school educated experts. The integration of basic knowledge improves the graduates implementation in praxis and at the same time maintains the diversified profiles of graduates, their specific knowledge and abilities. The university schoolbook multimedia content and the publication of elaborated lectures of the selected subjects and videopresentations of laboratory exercises on the internet pages of the both universities will allow students to manage effectively the study with their individual possibilities in accordance with the principles of the credit system. The university schoolbook will be consist of the key themes of study programmes core subjects. Its selected themes parts will be questions and problems of final exams at the both universities. The project outputs multimedia processing will be suitable mainly as a study materials for the combined and distance study method in the external study programmes and also as an innovative study material for the experts from praxis and non-academic sphere. The selected lectures presentations published in English language will be helpful for students from abroad. |

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| **Project title:** | **Progressive methods of material fire-technical characteristics determination in fire engineering** |
| Coordinator: | prof. Ing. Karol Balog, PhD. |
| Start date: | 24/10/2013 |
| End date: | 30/09/2017 |
| Programme: | APVV |
| Annotation: | The contribution to research in the area of fire engineering in accordance with world trends by utilisation of the progressive methods for determination of important fire-technical characteristics for calculation and modelling of compartment fires. The characterisation and verification of the laboratory testing methods with modern equipment utilisation for obtaining of the unique material characteristics and their alterations due heat and fire. The behaviour prediction of solid and liquid materials in the process of initiation and propagation of combustion on the ground of the determined characteristics. The application of new methods for determination of critical boundary conditions of testing of representative materials in the progressive material structures for the improving of outputs from used fire scenarios. |

## PROJECTS OF THE INSTITUTE OF APPLIED INFORMATICS, AUTOMATION AND MECHATRONICS

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| **Project Title** | **Knowledge discovery for hierarchical control of technological and production processes** |
| Coordinator | prof. Ing. Pavol Tanuška, PhD. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2017 |
| Program | VEGA |
| Annotation | The project is aimed at the area of knowledge discovery on databases and the application of such knowledge in hierarchical process control. It will include conceptual |

design of a knowledge discovery process in hierarchical control systems. The formulation of the proposal design will constitute comprehensive approach to solving problems related to processing of extreme amount of data for the purposes of complex system control. Selected methods of data mining, e.g., based on statistical and inductive learning techniques and chosen on the basis of defined criteria, will be compared in terms of several measurable criteria.

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| **Project Title** | **Research and development of a new autonomous system for checking a trajectory of a robot** |
| Coordinator | prof. Ing. Pavol Božek, CSc. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2017 |
| Program | VEGA |
| Annotation | The research project deals with implementation of hybrid sensors - an Inertial Navigation System which will be utilized for the calibration of a robotic workplace. The calibration is necessary for adapting the simulation of a production device model to real geometric conditions. Constructing the model of the production device, as well as creating the corresponding programmes of robots by means of a simulation system represents an exact picture of reality. The deflections of reality from the simulation arise from different reasons (position of work piece, geometric accuracy of a tool, etc.). The proposed INS will be utilized for their calibration without using the calibration agents. It will lead towards great simplification of calibration in practice. |

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| **Project Title** | **Design, analysis and optimization of processes of metallurgical joining for progressive materials using numerical simulation** |
| Coordinator | doc. RNDR. Mária Behúlová, CSc. |
| Start Date | 01/01/2016 |
| End Date | 31/12/2019 |
| Program | VEGA |
| Annotation | The project is focused on the design, numerical simulation, experimental verification and scientific explanation of the possibilities of joining the advanced light alloys based on Al, Mg, Ti, as well as new generations of high strength steels and their combinations including the formation of weld joints of these materials with composites/plastics. The preparation of sound welds is supposed using concentrated energy sources, welding methods in solid state, special, modified and hybrid welding methods, soldering and mechanical joining. In the theoretical field, the project should contribute to the explanation of physical and metallurgical causes and mechanisms of weld joints formation, determination of the effect of technological parameters on the quality of welds and extension of knowledge in numerical solution of coupled electro-magnetic, thermal, fluid, stress-strain and contact problems. Significant attention will be paid to the environmental and safety aspects of investigated technologies and materials. |

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| **Project Title** | **University textbook "The means of automated production" by interactive multimedia format for STU Bratislava and Kosice** |
| Coordinator | prof. Ing. Pavol Božek, PhD. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2017 |
| Program | KEGA |
| Annotation | The submitted project proposal is oriented on creating and integration of the content and design of multimedia applications to support the teaching of the newly accredited subject Means of automated production via written and interactive multimedia form to continuously complement and improve the level of technical subjects related to |

automation and their control systems at universities. The support of a better, stronger, more efficient perception of information from the textbooks in the subject "Means of automated production" (texts, images, graphics, speech, animations, video sequences) is enabled by multimedia and are presented in several formats.

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| **Project Title** | **Modernization of the Automatic Control Hardware course by applying the concept Industry 4.0** |
| Coordinator | Ing. Tomáš Škulavík, PhD. |
| Start Date | 01/01/2016 |
| End Date | 31/12/2018 |
| Program | KEGA |
| Annotation | The project is focused on the implementation and the use of the Industry 4.0 concept to modernize the syllabus of the course Automatic Control Hardware. A versatile, robust system will be developed within the project using the latest trends in automation and information technology. The use of the technological concept of the Cyber-Physical System will enable to improve not only the teaching of the subject Automatic Control Hardware, but also other subjects. The developed system could be used in teaching other subjects thanks to the database, which could be possibly complemented by a variety of relevant learning materials. The system will serve to students as well as teachers during the course itself, but also for home self-study. The system will be designed to support the teacher during the course as much as possible and to teach the students independence and analytical thinking. Another objective of the project is to introduce and teach the students and teachers to use the modern technologies by integrating them into the educational process. |

## PROJECTS OF THE ADVANCED TECHNOLOGIES RESEARCH INSTITUTE

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| **Project Title** | **Searching for physical sources of the fast stochastic oscillations in accreating systems.** |
| Coordinator | Mgr. Andrej Dobrotka, PhD. |
| Start Date | 01/01/2016 |
| End Date | 31/12/2018 |
| Program | VEGA |
| Annotation | The goal of the project is the study of the fast stochastic oscillations generated by turbulent accretion in cosmic objects, where the main driving mechanism is the accretion through a disc. This stochastic flickering usually does not originate only from a single source, hence the light curve is a superposition of more signals. Individual components can be identified by detailed study of the periodogram. For analysis of such complicated periodograms data with high cadence on long time-base are required. Ideal instrument satisfying such demands is the Kepler spacecraft. Its one-minute cadence on time-base over hundreds of days is a unique opportunity for our study. Together with our flickering simulating model based on turbulent accretion process we want to identify individual parts of the complicated periodograms calculated from Kepler telescope data, to localize their source and bring a complex model of accretion in some types of cosmic objects. |

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| **Project Title** | **High energy heavy ion-beam annealing of ion implantation synthesized silicon carbide** |
| Coordinator | Ing. Jozef Dobrovodský, CSc. |
| Start Date | 01/01/2016 |
| End Date | 31/12/2018 |
| Program | VEGA |

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| Annotation | SiC is a promising material for a wide range of applications from semiconductor industry to e.g. in fuel elements of next generation nuclear power plants' reactors. The most recent method for SiC synthesis is based on carbon implantation into silicon substrate followed by High Energy Heavy-Ion-Beam Annealing (HE HIBA) is currently under development. Advantages of HE HIBA annealing are significantly lower temperature requirements, possibility of localized synthesis and short time of treatment, among other things. Synthesized silicon carbide will be analysed and characterized by Rutherford backscattering spectrometry (RBS), Resonant Nuclear Reaction Analysis (R-NRA), X-ray diffraction (XRD) and transmission electron microscopy (TEM). Particularly the new experimental facility at MTF STU Trnava equipped with a 500 kV ion implanter and 6 MV tandem accelerator will be utilized. Relation between the main parameters of synthesis processes and of the resulting SiC layers will be studied. |

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| **Project Title** | **Design of Al-TM alloys for on-board hydrogen production** |
| Coordinator | RNDr. Martin Šulka, PhD. |
| Start Date | 01/01/2015 |
| End Date | 31/12/2018 |
| Program | VEGA |
| Annotation | The project is aimed on design of Al-TM metal aluminum alloys for on-board hydrogen production by hydrolysis, TM being Co, Ni, Pd, Rh. The goal of the theoretical part is to study the impact of chemical composition on electrochemical stability of aluminum alloys. By periodic DFT we will investigate the influence of chemical composition on electrode potential shift in alloys relative to pure aluminum. We will also examine the segregation of the given element, composition influence on adsorption energies of water and trends in electrochemical stability of alloy surface after the adsorption of water. Within the experimental part we will investigate the correlation between the chemical composition and microstructure of alloys, the influence of preparation conditions and cooling speed on phase composition. Further, we will study the corrosion activity of alloys with emphasis on rapid hydrogen production. Influence of electrolyte type will be evaluated and mechanisms of corrosion will be described. |

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| **Project Title** | **Physical properties of confined systems** |
| Coordinator | Mgr. Filip Holka, PhD. |
| Start Date | 01/01/2016 |
| End Date | 31/12/2018 |
| Program | VEGA |
| Annotation | An artificial confinement potential is used to model effects of chemical environment of viarious systems. It is widely used for modeling physical phenomena such as in-crystal polarizabilities, electronic structure of quantum dots, high-pressure effects on atoms and molecules and the systems included into nanosized cavities etc. In our project we will focus on particular problems namely: ab initio calculations of cationic in-crystal polarizabilities, cavity embedded molecules and NMR and hyperfine propeties of semiconductor quantum dots. |

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| **Project title:** | **Noncovalent interactions in systems of increasing complexity** |
| Coordinator: | RNDr. Andrej Antušek, PhD. |
| Start date: | 01/07/2016 |
| End date: | 30/06/2020 |
| Programme: | APVV |
| Annotation: | A common idea of this project is providing benchmark wavefunction data (mostly CCSD(T)) that would support DFT predictions of energetics and properties of gradually complex systems. Noncovalent interactions will be analysed, contributions |

many-body terms to the non additivity will be evaluated. As a prototype, beryllium clusters will be studied, binding energies per atom of Be_n up to the solid state will be of interest. The focus will be on interactions of biologically relevant amino acid clusters extracted from protein structures in the Protein Data Bank, their geometry and stability. Another class of molecules considered are metal-ligand complexes, including heavy metals. The main goal is to understand the bonding mechanism in context of their size, from small complexes to nanoclusters. Relativistic effects provide one of instruments for this analysis as well as for the analysis of iodine containing species relevant to coolant system of the nuclear reactor and in 12 complexes with antithyroid drugs. Many-body dispersion interactions will be treated using DFT in connection with layered materials and molecular crystals, their structure, elastic and thermal properties and adsorption. The alteration of properties of solute molecules in solvents, is another consequence of intermolecular interactions. This will be considered in relativistic calculations of NMR shielding constants. We combine wavefunction and DFT methods having in mind controlled accuracy. Large systems are treated using DFT, but selection of functionals is supported by extensive benchmarks on model systems. This will be achieved by further extension of efficiency of the wavefunction methods towards treating model systems closer to large molecules of interest. Important part of the project is the development of relativistic methods as well as improvement of methods for dispersion treatment within DFT. All methodological achievements will be implemented in computer programs MOLCAS, DIRAC and VASP.

**Project title:** **Slovak Centre of Excellence in Ion Beam and Plasma Technologies for Materials Engineering and Nanotechnology - SlovakION**

Coordinator: doc. Ing. Maximilián Strémy, PhD.
Start date: 2015
End date: 2016
Programme: H2020
Annotation: The Center of Excellence SlovakION aims to become Eastern Europe's leading research centre for ion beam and plasma technologies in materials engineering and nanotechnology. Based on cutting-edge research and closely integrated in an international network of research facilities. SlovakION's holistic approach to innovation transfer and its close interaction with the regional industry will contribute to the economic development of Slovakia. The main focus lies with the automotive and electronics industry as pointed out in Slovakia's Research and Innovation Strategy for Smart Specialisation.

## PROJECTS OF THE DEPARTMENT OF LANGUAGES AND HUMANITIES

**Project title:** **Student online conferences of STU MTF (Slovakia) and University of Niš, Faculty of Electronic Engineering (Serbia) for the purposes of specific English language and other skills development**

Coordinator: Mgr. Gabriela Chmelíková, PhD.
Start date: 01/01/2015
End date: 31/12/2016
Programme: APVV
Annotation: English has become a language of the international scientific communication, making its use a prerequisite for process in any field of science and technology. Since opportunities for young scientists or experts in the Slovak and Serbian universities to participate in prestigious conferences are quite limited by funding, on-line conferences offer an ideal platform for the exchange of professional information using technical English. The project will investigate similarities and differences in existing related study programmes, assess their mutual compatibility and compatibility with the EU standards via the on-line conferences it will determine

common interests and possible goals of the groups of prospective project partners (IT teachers, young researchers).

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| **Project title:** | **Transnational exchange of good CLIL practice among European Educational Institutions** |
| Coordinator: | Mgr. Ľudmila Hurajová, PhD. |
| Start date: | 2015 |
| End date: | 2017 |
| Programme: | ERASMUS+ |
| Annotation: | The document Education and Training in Europe 2020 describes diverse policy initiatives targeting young people under the age of 34 and highlights that "Foreign languages skills can enhance the employability of young people". This initiative totally fits the target groups of our project which are primary and secondary students. The proposed project is built on international collaboration which will result in increase flow of knowledge and good CLIL practice among education institutions, represented by Spanish and Latvian partners, research organizations, represented by both Slovak partners and finally representatives of schools in Lithuania and Sweden. Lithuanian and Swedish partners will aim at learning ways to implement good practices of CLIL in the classroom, while Spanish and Latvian partners will contribute by sharing a good CLIL practice. Slovak partners will focus on research part of the project. |