ADVANCED MATERIALS

The study of the soft magnetic composites with ferrite as an insulation part.
supervisor: doc. RNDr. Ján Füzer, PhD. (jan.fuzer@upjs.sk)
study form: full- time
Annotation: The study is oriented on investigation of the NiFe and FeSi based composite materials with ferrite as a nonconductive binder. Potential advantage of spinel ferrites when used as electroinsulating layer instead of other insulations is their ferrimagnetic behavior, improving the magnetic interaction between the ferromagnetic powder particles in the final composite. Part of the work is the investigation of the electrical resistivity, wideband complex permeability and energy losses in prepared soft magnetic composites. The aim is optimization of preparation process of soft magnetic materials with required magnetic properties at middle-frequencies.

Study of atomic structure of materials with high degree of structural disorder by scattering of X-ray radiation
supervisor: prof. RNDr. Pavol Sovák, CSc. (pavol.sovak@upjs.sk)
consultant: RNDr. Jozef Bednarčík, PhD. (jozef.bednarcik@upjs.sk)
study form: full- time
Annotation: Metallic glasses based on transition metals and nanocrystalline materilas derived from them exhibit very good mechanical and magnetic properties. One of the main aims of the proposed work is to study atomic structure of selected amorphous and nanocrystalline materials by scattering of X-rays using laboratory diffractometers and instruments available at synchrotron source PETRA III in Hamburg. Special emphasis will be placed on understanding of correlations between macroscopic properties of studied materials and their atomic structure during application of external factors such as temperature, pressure and mechanical deformation.

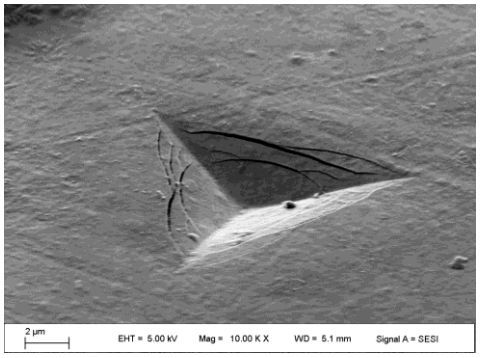
Structure and properties of ferroic ceramics).
Supervisor: RNDr. Vladimír Kovaľ, PhD. (vkoval@saske.sk) - Institute of Materials Research Slovak Academy of Sciences Košice
study form: full- time
Annotation: The dissertation will be focused on investigation of the crystal structure and physical properties of ferroelectrics and other ferroic (magnetic, magnetoelectric) materials prepared as bulk ceramics. In course of research work, theoretical and experimental approaches such as synthesis of experimental materials via solid state reaction, structural XRD analysis and Rietveld refinement, scanning and transmission electron microscopy, and characterization of fundamental physical (electrical, magnetic) parameters of functional ceramics will be carried out. An AC impedance spectroscopy will be adopted and modified in order to evaluate the effect of the preparation and chemical composition on the microstructure and dielectric response of the materials considered.

Highly ionized plasma sputtering of multicomponent high entropy ceramic coatings
supervisor: doc. RNDr. František Lofaj, DrSc. (flofaj@saske.sk) - Institute of Materials Research Slovak Academy of Sciences Košice
study form: full- time
Annotation: The development of magnetron sputtering is oriented toward technologies with high ionization degree of the sputtered material which provides better control of the deposition process as well as better coating properties. The most famous ionized PVD is the High Power Impulse Magnetron Sputtering (HiPIMS) and the relatively new technology High Target Utilization Sputtering (HiTUS) also belongs among these methods. High degree of ionization is achieved in the case of HiPIMS by very short duty cycle impulses with extremely high power density whereas in HiTUS by the power at an independent plasma source. The work should focus on the optimization of the deposition parameters of hard multicomponent carbide, boride and nitride coatings from the viewpoint of the control of their elastic and plastic properties by means of determination of dependencies among the deposition parameters, plasma

characteristics, coating structures and their mechanical and tribological properties. The work will be performed on the iPVD systems Cryofox Discovery (Polyteknik, Denmark) and HiTUS C500 (PQL, UK) in combination with the electron microscopy observations (SEM, TEM) and measurements of mechanical properties.


HiPIMS Discovery

HiTUS C500



nanoindentation in W-C coating

Design and characterization of carbon fibers doped by metals nanoparticles for effective hydrogen evolution

supervisor: RNDr. Magdaléna Strečková, PhD. (mstreckova@saske.sk) - Institute of Materials Research Slovak Academy of Sciences Košice

study form: Full- time

Annotation: Hydrogen produced from renewable energy sources is nowadays considered to be a fuel of the future that has the potential to reduce the energy dependence of developed countries on oil imports and to improve the quality of human life. Hydrogen produced from electrolysis of water could be a sustainable source of energy without significant emissions of pollutants or other environmental or health hazards. However the simple, efficient, and secure methods of hydrogen retrieval must be developed before it can be recognized as an economically significant resource with an exceptional energy potential. The dissertation work is devoted to the preparation of new catalysts for the effective hydrogen evolution from water. The porous carbon fibers modified with metallic nanoparticles and metallic phosphide nanoparticles will be prepared by needle-less elektrospinning technology from the free surface of polymers, to catalyze the production of hydrogen at low overpotential like platinum or rare metals. The prepared fibers will be characterized by the most up-to-date methods to elucidate the effect of the properties on the final electrochemical parameters of the hydrogen evolution process.

Correlation of structural and physical properties of sintered soft magnetic composites

supervisor: Ing. Radovan Bureš, CSc. (rbures@saske.sk) - Institute of Materials Research Slovak Academy of Sciences Košice

study form: full- time study

Annotation: The work is focused on study of influence of structural parameters on physical properties of powder press&sinter soft magnetic composites. This composite materials are based on ferromagnetic powder particles coated with dielectric coating layer. Properties of the composite are significantly influenced by chemical and phase composition as well as volume distribution of ferromagnetic and dielectric component. Structural parameters obtained by method of quantitative metallography and stereology will be correlated with magnetic and mechanical properties of selected composites. Obtained results will be used in research, development and optimization of method production method for soft magnetic materials suitable for middle-frequency applications.

Microwires with shape memory effect

supervisor: doc. Ing. Ondrej Milkovič, PhD. (omilkovic@saske.sk) - Institute of Materials Research Slovak Academy of Sciences Košice

consultant: prof. RNDr. Rastislav Varga, DrSc. (rastislav.varga@upjs.sk)

study form: full- time study

Annotation: Shape memory alloys (JTP) already have their representation in applications. Developments have revealed compositions with excellent shape memory effects such as Nitinol or various Heusler alloys used in aerospace technology, sensors and actuators, and in alternative energy. The new dimension in the applicability of these materials is opened by the preparation of microwires with shape memory effect using the Taylor-Ulitovski method. The topic of the dissertation is focused on the study of the shape memory and properties of Heusler alloys in relation to their structure and method of the prepared alloy. It is expected that by local analysis such as SEM, TEM, and micro-XRD will be possible to explain the effect of the core-shell interface on the properties and structure formation of the microwires with the shape memory effect.