# *Questionnaire*

## Summary of the main activities of a scientific Organisation of the Slovak Academy of Sciences

*Period: January 1, 2007 - December 31, 2011*

## *I. Formal information on the assessed Organisation:*

### 1. Legal name and address

Institute of Electrical Engineering SAS
Dúbravská cesta 9
841 04 Bratislava

### 2. Executive body of the Organisation and its composition

| Directoriat | name | age | years in the position |
|---|---|---|---|
| **director** | Ing. Karol Fröhlich, DrSc. | 57 | 9 |
| **deputy director** | RNDr. Vladimír Cambel, CSc. | 55 | 6 |
| **scientific secretary** | Mgr. Bohumír Zaťko, PhD. | 38 | 2 |
| **deputy director for infrasctructure** | Ing. Ján Fedor, PhD. | 35 | 3 |
| **scientific secretary** | RNDr. Marianna Španková, PhD. | 42 | 3 |

### 3. Head of the Scientific Board

Ing. Štefan Chromik, DrSc. 2006 - 2010
RNDr. Martin Moško, CSc. 2010 – 2011
Ing. Ján Kuzmík, DrSc. 2011 -

### 4. Basic information about the research personnel

**i. Number of employees with a university degree (PhD students excluded) engaged in research and development and their full time equivalent work**

**capacity (FTE) in 2007, 2008, 2009, 2010, 2011 and average number during the assessment period**

**ii. Organisation units/departments and their FTE employees with the university degree engaged in research and development**

| Research staff | 2007 | | 2008 | | 2009 | | 2010 | | 2011 | | average | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | FTE | No. | FTE | No. | FTE | No. | FTE | No. | FTE | No. | FTE |
| organisation in whole | 77 | 58,36 | 77 | 55,02 | 74 | 58,77 | 75 | 63,63 | 80 | 60,58 | 76,5 | 59,5 |
| Dept. of Thin Oxide Films | 10 | 9 | 11 | 8,08 | 11 | 7,08 | 12 | 6,76 | 10 | 6,14 | 10,80 | 7,41 |
| Dept. of Optoelectronics | 13 | 11,2 | 14 | 10,16 | 13 | 11,6 | 13 | 11,3 | 11 | 8,62 | 12,80 | 10,58 |
| Dept. of Semiconductor Technology and Diagnostics | 7 | 5,98 | 7 | 5,83 | 8 | 5,86 | 7 | 4,93 | 7 | 4,93 | 7,20 | 5,51 |
| Dept. of Superconductor Physics | 14 | 7,42 | 15 | 8,13 | 15 | 7,57 | 18 | 11,19 | 15 | 13,07 | 15,40 | 9,48 |
| Dept. of Cryoelectronics | 6 | 4,38 | 6 | 5,08 | 6 | 4,88 | 6 | 3,55 | 6 | 3 | 6,00 | 4,18 |
| Dept. of Microelectronic Structures | 5 | 3,68 | 5 | 3,68 | 6 | 3,76 | 6 | 4,6 | 9 | 5,18 | 6,20 | 4,18 |
| Dept. of Theory of Semiconductor Microstructures | 9 | 4,11 | 8 | 2,41 | 7 | 3,12 | 6 | 3,08 | 0 | 0 | 6,00 | 2,54 |
| Dept. of Superconductor Electrodynamics | 6 | 6 | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 2,20 | 2,00 |
| Dept. of Superlattices | 7 | 5,58 | 5 | 5,08 | 5 | 5,08 | 6 | 4,96 | 6 | 5,08 | 5,80 | 5,16 |
| Dept. Nanostructure Physics | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 6,45 | 2,40 | 1,29 |

## 5. Basic information on the funding

**i. Total salary budget[1] of the Organisation allocated from the institutional resources of the Slovak Academy of Sciences (SAS) in 2007, 2008, 2009, 2010, 2011 and average amount for the assessment period**

| Salary budget | 2007 | 2008 | 2009 | 2010 | 2011 | average |
|---|---|---|---|---|---|---|
| total salary budget (milions of EUR ) | 0,85 | 0,90 | 0,95 | 0,97 | 0,93 | 0,92 |

## 6. URL of the Organisation's web site

http://www.elu.sav.sk/

[1] Objem mzdových prostriedkov bez odvodov do poisťovní so započítaním sumy miezd pracovníkov THS, ktorú organizácii poskytne ETO Úradu SAV. Rozpočet v Sk prepočítajte na eurá podľa konverzného kurzu 1€ = 30,126. (Podobne aj v ďalších tabuľkách.)

# *II. General information on the research and development activity of the Organisation:*

## 1. Mission Statement of the Organisation as presented in its Foundation Charter

1. The activity of the Institute is focused on research and development in the field of electrical engineering, automatisation and controlling systems, physical sciences as well as on nanotechnology aimed at physical and material research of semiconductors and superconductors and on their technical application.

2. The Institute offers consulting and expert services, related with the main activity, using equipments and know-how of scientific organisation for domestic and foreign customers, including leasing or sale of unique devices and equipments developed and produced in the Institute for payment from domestic and foreign customers.

3. The Institute provides production, storing, distribution and sale of cryogenic media, mostly for use of institutes of SAS as well as for domestic and foreign customers.

4. The Institute provides scientific education of new researchers in scientific fields falling into domain of scientific activity of the Institute within implication of generally valid legal rules and laws. The Institute provides involvement of its employees in educational process in universities.

5. The Institute provides publications of research results by means of periodical and non periodical press. Publishing of periodical and non periodical press obeys decisions of the Presidium of SAS.

The institute is training institution for education of new researchers in the section 5.2.48 Physical engineering, 4.1.3 Physics of condesed matter and acoustic, 5.2.13 Microelectronics. The Institute realizes preparation and education of researchers for needs of SAS research institutes and other institutions.

The Institute is a co-publisher of the Journal of Electrical Engineering.

## 2. Summary of R&D activity pursued by the Organisation during the assessed period, from both national and international aspects and its incorporation in the European Research Area (max. 10 pages)

The Institute deals with current problems in solid-state physics, material research, microelectronics, and electrical engineering. Research, performed in the Institute falls into following domains:

- New materials and technologies for microelectronics;
- Development and application of new structures for sensors and advanced microelectronic devices;
- New materials and devices for applied superconductivity.

Research activity in these fields resulted in increase of knowledge in solid state physics, material science, development of new technologies and new microelectronic devices as well

as understanding of behaviour of advanced superconducting devices. In the following paragraphs we discuss selected outstanding results achieved during the assessed period.

**Selected outstanding results achieved during the assessed period**

New materials and technologies for microelectronics

We have studied quantum electron transport in disordered mesoscopic conductors. It was found that if an electronic conductor is small enough, the conduction electrons succeed in passing through the conductor without colliding with a vibrating atomic lattice and also without colliding with other electrons. In this case the conduction electrons behave like waves and the wave properties are directly manifested by macroscopic properties of the conductors, for instance by its conductance. The conductor is called mesoscopic, because its properties are governed by microscopic physical laws (by quantum mechanics) albeit it consists of a macroscopic number of atoms. Of special interest is a ring-shaped mesoscopic conductor which represents an elementary electronic circuit. If such ring is pierced by constant magnetic flux, it supports a persistent current that flows without any voltage source and without dissipating the Joule heat. The purpose of our research was to describe these mesoscopic conductors theoretically starting from the first principles. We have developed a quantum simulation which allows to calculate the conductance/current in mesoscopic conductors/rings with realistic disorder due to polycrystalline grains, impurity atoms and rough sample edges. The results of our calculations allow to understand the quantum-mechanics-related properties of electronic devices, emerging owing to the fast progressing miniaturization towards mesoscopic dimensions.

Local anodic oxidation (LAO) realized by the tip of an atomic force microscope (AFM) was employed to define nano-scale devices. We studied the influence of electric field distributions between the sample and the tip on local anodic oxidation. It was shown theoretically and experimentally that the conductivity of a sample is the most important parameter which controls the thickness of oxide lines prepared by LAO. A low conductivity of a sample is conducive to the formation of wide double maxima oxide lines under the tip. We explained the effect using numerical simulations using a finite element method. The results helped us to introduce a novel AFM LAO technique based on the use of an innovative material system (GaAs/AlGaAs/InGaP) and on the removal of oxide lines. The technique was used to form oxide lines as thin as 50 nm, which is a 50% reduction compared with lines formed by traditional approaches. Hence, even thinner nano-scale elements for quantum informatics and other applications can be realized using the technique.

We also focused on the development of high permittivity (high-κ) structures for nano-scale random access memories (DRAM). For DRAM cells to be further down-scaled, it is necessary to use a charge storage capacitor with very a high-κ dielectric. In our approach, $RuO_2$ layers, deposited by metal organic chemical vapour deposition, were used for the bottom electrode. As the second step, titanium dioxide thin films were grown using atomic layer deposition by our colleagues from Tartu University, Estonia. A stabilizing effect of the bottom rutile-type $RuO_2$ layer resulted in the growth of $TiO_2$ rutile films at low temperatures. The stabilization of the $TiO_2$ rutile phase occurred due to the local epitaxial growth of a polycrystalline $RuO_2/TiO_2/RuO_2$ structure, as was revealed by transmission electron microscopy. The capacitance-voltage measurement showed that the $TiO_2$ films exhibited a dielectric constant as high as 155. An $SiO_2$ equivalent thickness as low as 0.5 nm was obtained for the 20 nm $TiO_2$ thin film prepared at 425 °C.

We studied the role of growth mode in the formation of magnetic properties of InMnAs films and quantum dots grown by metal organic vapour phase epitaxy. Ferromagnetic semiconductors are intensively studied because of their possible application in spintronics. Pairs of self-assembled InMnAs quantum dot structures and reference epitaxial layers ($0 < x < 0.13$) were prepared on GaAs substrates by low-pressure metal organic vapour phase epitaxy (J. Novák et al., Appl. Surface Sci. 256 (2010) 5672). The magnetic moment measurement indicated that the reference epitaxial layer had a Curie temperature of 343 K

independent of the composition. However, the quantum dots prepared under Stranski–Krastanov growth mode from the identical gas phase composition showed lower values of Curie temperature, which varied from 41 to 235 K in relation to the material composition. The moiré fringes at transmission electron microscopy plan views were used to characterize strain in the InMnAs quantum dot structures.

Development and application of new structures for sensors and advanced microelectronic devices

Interesting results were achieved in the development of GaN-based high electron mobility transistors (HEMT) for high-power and high-frequency applications, such as mobile communications. High leakage current flowing through the control gate of a classical HEMT transistor with a Schottky barrier (SB) substantially limits this application. A decrease in the leakage currents of about 6 orders of magnitude was achieved in metal-oxide-semiconductor (MOS) HEMTs that had 12 nm thin insulating $Al_2O_3$ film deposited by metal organic chemical vapour deposition. The MOS HEMT also showed an improvement in the maximal drain current density and extrinsic transconductance. Analytical modelling showed that a higher mobility of electrons in the channel of the MOS HEMT and consequently a higher number of electrons attaining the velocity saturation may explain the observed increase of the transconductance after the gate insulation.

Research activities in the field of passivation of AlGaN/GaN HEMTs were devoted to the investigation of plasma recess-gate etching and the passivation of the AlGaN barier layer. We proposed a novel approach to the plasma passivation of the Schottky barrier gate interface of the HEMT structures. It lies in a shallow recess-gate $CCl_4$ plasma etching of the AlGaN barrier layer in combination with “in-situ” SF6 surface plasma treatment applied selectively under the Schottky gate. A significant impact of the plasma passivation on both the current gain cut-off frequency ($F_t$) and maximum oscillation frequency ($F_{max}$) was observed. We discovered that the plasma treatment additionally performed under the Schottky gate improved $F_t$ and $F_{max}$ almost by about 60 %. One can therefore expect that such plasma passivation treatment should be beneficial for the development of the sub-micrometer gate length AlGaN/GaN HEMT for millimeter wave band applications.

Interesting results were achieved in the development of GaN-based high electron mobility transistors (HEMT) for high-power, high-frequency applications, e.g. for mobile communication or wireless transfer of large data volumes. High leakage current flowing through the control gate in the classical HEMT transistor with a Schottky barrier substantially limits this application. The necessity to insulate the gate and passivate the device surface led to intensive research. Atomic layer deposition (ALD) of $Al_2O_3$ was used to prepare metal-oxide-semiconductor (MOS) devices on two different AlGaN/GaN heterostructures, with and without a thin GaN cap layer (D. Gregušová et al., J. Appl. Phys. 107 (2010) 106104). Their trapping effects were evaluated by the frequency dependent conductance measurement. The trap state density decreased sharply from $\sim 1\times10^{12}$ $cm^{-2}\,eV^{-1}$ at the energy of 0.27 eV to $\sim 3\times10^{10}$ $cm^{-2}\,eV^{-1}$ at 0.45 eV. The low trap state density and exactly exponential dependence of the trap state time constant on the gate voltage show a good quality of the gate oxide. The trap state density in the structure with a GaN cap layer was about 2–3 times lower than that in the structure without a cap layer, which might be due to the different $Al_2O_3$/GaN and $Al_2O_3$/AlGaN interface properties. The trap state density in the structures investigated is lower than those reported for the devices with the metal-organic chemical vapour deposition and Al-oxidized $Al_2O_3$ gate oxide. This shows that the ALD technique is important for the preparation of high-performance AlGaN/GaN MOS transistors.

A special technique for the determination of the interface density in Ni/$Al_2O_3$/InAlN/AlN/GaN metal-oxide-semiconductor heterostructures was developed (M. Ťapajna et al., Semicond. Science and Technol. 24 (2009) 035008). The technique is based on the measurement of capacitance–voltage and capacitance–time characteristics between 25 and 300°C. An anomalous positive voltage shift of the capacitance–voltage curve with

increasing temperature was observed and attributed to the hole emission from the oxide/semiconductor interface states. The distribution of the interface states density, $D_{it}(E)$, at the $Al_2O_3$/InAlN interface was evaluated using a modification of the constant-capacitance deep-level transient spectroscopy. The MOS-H capacitor threshold voltage shift under negative bias was repetitively recorded as a function of time at elevated temperatures. $D_{it}$ in the range of 0.1–3 × $10^{13}$ $eV^{-1}$ $cm^{-2}$ was determined. The hole trapping at the oxide/InAlN interface was assumed to be a dominant effect responsible for the gate-lag effect in InAlN/GaN MOS HEMTs.

V-shaped X-ray monochromators are used for X-ray beam modification in structural analysis. In standard single-crystal V-channel germanium (220) X-ray beam-expanding/compressing monochromators for $CuK_{\alpha 1}$ radiation, a total beam expansion/compression of 5 and 10 corresponding to the asymmetry angles of 9 and 12° is achieved, respectively. Higher one-dimensional beam expansion/compression is achievable using larger angles of asymmetry at the expense of a decrease in the total intensity. To increase the intensity, a linearly graded Ge-rich GexSi1−x single crystal was used to prepare a monochromator with 15° asymmetry angles (total expansion/compression factor of 21) for $CuK_{\alpha 1}$ radiation (D. Korytár et al., J. Appl. Crystallography 43 (2010) 176). The X-ray diffraction measurements show more than a three times higher peak intensity at the output compared with that of a pure Ge monochromator.

New materials and devices for applied superconductivity

Our superconductivity research was focused on the development of technical superconductors and the application of high-$T_c$ superconductors for laboratory use and energy transmission. The transport current densities of stabilized multi-core $MgB_2$ composite wires were significantly increased within the 6th Framework Programme project HIPERMAG. The level of critical current density Jc=10 000 $Acm^{-2}$ measured in an external field of 6 T at the beginning of the project (2005) was due to the current carrying capacity improvement obtained at a much higher field of 11.3 T at the end of project (2008). In addition to high Jc values at liquid helium temperatures due to the depression of secondary phase formation, the thermal stability and the resistance of $MgB_2$ wires to mechanical stresses were also improved. The achievements increase the potential of the material in future industrial applications, e.g. superconducting magnets for magnetic resonance imaging (MRI) or current limiters for safety energy distribution systems. The results achieved by the team dealing with superconductivity were published in 9 scientific papers in 2007 and 2008.

The electromagnetic properties of a superconducting pancake coil in an AC regime as a function of the number of turns were studied theoretically and experimentally. In particular, the AC loss, the coil critical current and the voltage signal were analysed. The coils were made from a $Bi_2Sr_2Ca_2Cu_3O_{10}$/Ag (BiSCCO) tape, although the main qualitative results are also applicable to other kinds of superconducting tape, such as coated conductors. The AC loss and the voltage signal were electrically measured using different pick-up coils with the help of a transformer. The application of the technique avoided the effect of huge coil inductance. In addition, the critical current of the coil was experimentally determined by a conventional DC measurement. The critical current, the AC loss and the voltage signal were simulated, showing a good agreement with the experiments. For all simulations, the field dependent critical current density inferred from DC measurements on a short tape sample was taken into account.

$MgB_2$ superconductor is a promising material for applications at a temperature of 20 K. Current efforts are aimed at the preparation of this material in a form, suitable for technical applications. We assembled multi-core $MgB_2$ wires, cables and continually transposed conductors from a single-core in-situ made Ti/Cu sheathed composite (I. Hušek et al., Cryogenics 49 (2009) 366). It was shown that the filament current densities $J_c$ of a composed wire, cable and transposed conductor are comparable, but the engineering current densities $J_e$ and the window current densities $J_w$ were a lot different. The $MgB_2$ cable apparently

showed a lower sensitivity to bending strain than a monolithic wire. Instead of the highest $J_w$ for the transposed conductor, it offered also a high surface-to-volume ratio, which is an important parameter for an efficient cooling and thermal stability. The measurement of the resistance to tensile strain showed the best performance for the monolithic wire and the lowest irreversible strain for the continually transposed conductor.

The second generation superconductors, such as $Y_1Ba_2Cu_3O_x$ (YBCO), are usually produced as several millimetre wide tapes. To decrease losses in the alternative current (AC) applications, it is necessary to divide the tape to narrow mutually transposed strips. We proposed a model of a flat AC cable with resistively joined strips of an YBCO-coated conductor (M. Polák et al., Supercond. Science and Technol. 23 (2010) 025025). Current-voltage curves, losses in AC external magnetic fields and losses due to AC transport current at various frequencies up to 453 Hz were measured. The critical current of the cable at 77 K and self-field was ~160 A. It was shown that the resistive losses in the joints between the stripes did not significantly contribute to the total cable losses exposed to an AC external magnetic field.

The ceramic $Yba_2Cu_3O_{10}$ becomes superconducting, and thence it presents no electrical resistivity, below the temperature of the liquid nitrogen. Metallic tapes covered with a thin layer of this ceramic (superconducting tapes) may replace copper conductors in the future. Thanks to the capability to carry significantly larger currents, these tapes can reduce the size of windings and reduce their weight. The absence of resistivity is limited to currents below a certain value, called the critical current. This critical current depends on the magnitude and direction of the magnetic field. After an extensive study, we found a mathematical expression for this relation (E. Pardo et al., Supercond. Sci. Technol. 24 (2011) 065007), which can be directly applied for the design of superconducting power devices. Afterwards, we applied this mathematical expression to predict several features for two practical cases. The first case is cables for superconducting windings. We studied the effect of the contact resistance between strands on the cable current capacity and the amount of energy loss due to an external alternating magnetic field with any orientation with the cable. The second case is tokamak magnets for nuclear fusion experiments. Our calculations estimated the amount of superconducting tape required to replace the copper windings with superconducting ones for one particular facility.

**Incorporation of the research in the European Research Area**

We participated in several projects under the $6^{th}$ and $7^{th}$ Framework Programmes in the field of microelectronics and applied superconductivity. Besides Framework projects that continued from the preceding period, several new projects started within the assessed period 2007-2011. In the following paragraph we will comment the most important EU projects performed within the assessed period.

The Institute was involved in the “More Robust Gallium Nitride” project, MORGaN, supported within the $7^{th}$ Framework Programme. The integrated project MORGaN includes 23 research laboratories and companies from France, Germany, the Czech Republic, the United Kingdom, Switzerland, Sweden, Greece, Poland, Hungary, and Austria. The project addressed the application of GaN-based materials for electronic devices and sensors that operate in extreme conditions, especially at high temperatures and high electric fields. The Institute developed insulation/passivation stacks for high-frequency and high-power InAlN/GaN-based transistors. The project was successfully accomplished in 2011.

In 2011 the project entitled “GaN-based normally-off high power switching transistor for efficient power converters” was launched. The aim of the project is to develop highly efficient, thermally and electrically well performing GaN-based power devices on Si as a substrate material. The role of the Institute is in design and development of explorative GaN-based devices. Eight partners from 5 European countries are involved in the project.

Applied superconductivity was promoted within a Maria Curie Training Network project entitled “Nano-Engineering Superconductors for Power Applications”, NESPA. The NESPA project started at the end of the year 2006 and involved 10 research institutions from 7 European countries. Its activity focused on the involvement of young researchers in applied superconductivity. The project finished in 2010.

A project of the 7th Framework entitled “Development and field testing of an efficient YBCO coated conductor based fault current limiter in electricity networks” started in 2010. Within the project, researchers from the Institute are expected to minimize alternative current losses of a superconducting current fault limiter. The current limiter will be tested in the electricity network of Eastern Slovakia.

As follows from the Institute’s successful participation in the highly competitive environment of the EU Framework Programme, the most promising and successful research topics the Institute worked on between 2009 and 2010 were the technology of GaN-based devices and applied superconductivity.

## 3. Concept of R&D activity of the Organisation for the next four years (max. 5 pages)

Concept of the research and development activity of the Institute of Electrical Engineering for the next four years is envisaged in following main domains:

- New materials and technologies for microelectronics
- Development of new microelectronic structures, advanced sensors and electronic devices
- Applied superconductivity
- power engineering

Focus in superconductivity research is expected to gradually shift toward applied superconductivity and applications in power engineering. In the following paragraphs the concept will be discussed from the point of present state of knowledge and organisation’s role. Finally, objectives of the concept and proposed strategies will be proposed.

### i. Present state of knowledge and status of ongoing research related to the subject of the Concept, from both international and national perspective

Research of new materials for microelectronics is driven by the development of new technological processes. Advanced thin film technologies like atomic layer deposition (ALD), metal organic chemical vapour deposition (MOCVD) and pulsed laser deposition (PLD) are nowadays applied in micro- and nano-electronics research as well as in industrial applications. These techniques are reproducible, versatile and capable to control microstructure on a nanometer scale. Further development of thin film growth of semiconductors, insulators, metals and superconductors is prerequisite for a preparation of novel structures and devices.

Advanced patterning techniques such as focused ion beam, scanning electron microscope with electron beam lithography are used to define sub-micrometer structures necessary for new devices. High permittivity oxides are introduced to novel microelectronic devices to increase their performance. Novel structures relevant to the Institute activity include memory elements, magnetic nano-objects, active tips for scanning probe microscopy, micro and nano- electro mechanical systems (MEMS-NEMS), semiconducting detectors of X-ray radiation, and new structures for solar cells with enhanced efficiency and high-electron mobility transistors (HEMT) based on III-N heterostructures. III-Nitride-based HEMTs are top candidates for a new generation high-power and high-frequency amplifiers because of

extreme material ruggedness, strong piezoelectric and spontaneous polarization phenomena creating high density of a two-dimensional electron gas in a heterostructure quantum well. Unprecedented results are obtained in terms of the device microwave power and kW-class AlGaN/GaN HEMT amplifier already became a reality. On the other hand, large energy band-gap and consequently relatively high effective mass of electrons in the commonly used GaN channel makes the III-N HEMT development towards the ultra-high frequency range applications a challenging subject of the research. Similarly, technological problems of achieving depletion mode of the HEMTs operation hinder developments of possible GaN-based switches and GaN-based digital logic. Alternatively, recent investigations of the electronic transport characteristics of graphene have revealed its great potential for future electronics.

We suppose a high application potential of the proposed devices and sensors in microelectronics, automobile industry, energy management and in the inspection of the quality of environment. For these novel structures and devices also the methodology of characterization and testing such as high-frequency, low temperatures characterization, high resolution TEM etc., is currently developed.

The research in applied superconductivity is focused to application of high temperature superconductivity and development of filamentary composite superconductors. A new superconducting materials (e.g. YBCO, DyBCO and $MgB_2$), that offers specific advantages over commercially used superconductors, will have a double impact: it will consolidate the use of superconductors in areas where they are already common place, such as the bio-medical and research sector. European industry is excellent in these areas, however in order to maintain high level of competitiveness, it is vital for European research to be at the fore-front of the development of this new material into a practical superconductor. It will facilitate a real breakthrough in areas where existing superconductors presently have only a marginal impact, such as in the energy-related domain.

High temperature superconductors are up to now confronted with technological obstacles resulting in high price. Very promising are second generation superconductors (YBCO, DyBCO,…) with high current densities prevailing, mainly in current transport, properties of the conductors of first generation (e.g. Bi-2223/Ag). The Institute participates in research oriented to the preparation and application of these conductors in cables, coils and generators with high relation between power and mass.

$MgB_2$ offers a range of reasonably high operating temperatures (15 to 25 K, $T_c$=39 K) that allows for the use of much more modern and practical cooling technologies, as cryocoolers. The future research of $MgB_2$ as light and cheaper material should be focused on improvement of transport properties of filamentary composite superconductors, stability, and conductor design and on decreasing of AC losses. Moreover, in order to reduce the coupling currents between the filaments, twisting will be implemented onto the fine-filamentary $MgB_2$ conductor, the external matrix should be composed by a non-magnetic material and the filaments dimensions should be minimized and separated by a high electrically resistive barrier.

Application of superconducting devices is foreseen in power engineering. Superconducting wires and tapes can carry high current densities with negligible resistive dissipation. Thanks to this, motors, generators, transformers, and other types of electrical machines with superconducting windings are lighter and more efficient (especially at low loads) than the conventional ones. High power-over-weight ratio is essential for wind generators and transportation. In addition, superconducting motors provide an increased torque comparing to the conventional ones, which is interesting for some niche industrial applications like press machines.

The utilization of superconducting magnets for the generation of toroidal and poloidal magnetic fields is an essential feature of the fusion machine that should exhibit a positive power balance. The use of cables based on high-temperature superconducting coated conductor materials or the mid-term superconductor $MgB_2$ offers the possibility to reduce the cooling power significantly.

### ii. Organisation's role or significance in the overall research effort within the field of the Concept on both the national and international scales

In the next period we would like to stimulate research development in the main directions: materials and technology, structures and devices for microelectronics, applied superconductivity and in utilization of superconducting devices in power engineering. The role of the Institute is to provide a background infrastructure for the development. Thanks to successful participation in the projects of EU structural funds in the preceding period Institute has builded up new clean room with optical lithography, electron beam lithography laboratory, laboratory for nanostructures equipped by focused ion beam microscope and laboratories for thin film growth (ALD, PLD). To become competitive partner on the international level completing of this infrastructure by metal organic chemical vapour deposition equipment for III-N heterostructures, dry etching and analytical techniques is necessary.

The lack of liquid helium that in the past hindered research at low temperatures was successfully overcome by cooperation with the Technical University of Wien. Based on this cooperation researchers from the Institute receive regularly liquid helium for very convenient price. To promote the experimental research in applied superconductivity superconducting magnets, necessary for characterization of large size samples of superconductors, should be procured.

The Institute has to maintain its leading position on a national level in the cooperation with universities and other institutes of the SAS. The researchers will be encouraged to participate at the education at universities. However, its relation with local industrial partners should be improved, thereby accelerating transfer of knowledge toward application. The Institute will rely on its international cooperation to facilitate contacts of researchers with groups and laboratories within Europe. Significance of the Institute and its position on the international scale should be further reinforced by integration in the European Research Area. The Institute will offer its infrastructure as a support for organisation of scientific events – seminars, workshops and conferences.

### iii. Objectives of the Concept

In general, main objectives for the next period include:

- Increase of knowledge in solid state physics, microelectronics and applied superconductivity and its dissemination in high ranking international scientific journals, presentation at international conferences;
- Successful participation of the research teams in the EU Framework Programme as well as in national projects;
- Contribution to the industry development on national level through increased cooperation with the local industrial partners;
- Education of young researchers;
- Improvement of research infrastructure;
- Popularization of the science.

Following research activities are necessary to achieve the main objectives:

- Development of appropriate simulation methods for better understanding and prediction of behaviour of electronic devices;
- Development of advanced thin film technologies, in particular atomic layer deposition, metal-organic chemical vapour deposition, pulsed laser deposition etc.;

- Development of new emerging materials and mesoscopic structures;
- Structural characterization of thin films and structures;
- Application of thin oxide films in semiconductor devices with the aim of increasing their performance;
- Proposition of novel electronic devices (e.g. III-N HEMT device concepts and development of technologies, enabling break-through towards ultra-high frequency and/or towards normally-off device operation);
- Complex study of the preparation, characterization, simulation and testing of GaN based sensors for harsh environment, active tips for scanning, detectors and other advanced novel sensors and devices developed at the Institute;
- Development of the methodology for electrical characterization of the nano-scaled structures and devices;
- Development of technical filamentary superconductors based on $MgB_2$ and YBCO;
- Development of experimental methods for monitoring of superconducting wires, tapes and cables properties with respect to their stability, critical currents distribution, thermal transport properties and AC losses;
- Study of dissipative processes in high temperature and filamentary composite superconductors and windings at DC and AC conditions;
- Design and construction of superconducting windings for generation of magnetic fields, transformers, cables and generators with high relation between power and overall mass;
- Study of superconducting magnetic systems for fusion reactors.

### iv. Proposed strategies and methods to be applied, and time schedule

Infrastructure of the Institute has been significantly improved in the last period. The Institute acquired several new equipments. It is necessary to implement these new tools to research projects. To achieve proposed concept of the research and to keep pace with leading research groups in the field throughout the Europe it necessary to accomplish innovation of the research infrastructure of the Institute exploiting structural funds. As a result of internal discussions, we have prepared a list of technological facilities necessary for further development of the Institute. The list includes technological equipment for GaN thin film heterostructure growth and characterization and new magnets for generation of high magnetic field. The effort is actually concerted with other institutes of Slovak Academy of Science in order to prepare final large project of material research for application within the period of structural funds 2007 – 2013.

To keep and even improve position of the Institute on the international level cooperation with leading groups in the fields of thin film technologies, microelectronics and applied superconductivity should be preserved (e.g. cooperation with the III-V Thales France, FBH Berlin, Forschungszentrum Julich, TU Wien, IMEC Leuven, Argonne Natl. Lab., IHP Frankfurt (Oder), Karlsruhe Institute of Technology …). The research groups of the Institute will be encouraged to apply for international projects, focusing on the Framework Programme.

Improved position of the Institute relative to local industry should be achieved through more intensive contacts with industrial partners. The Institute is an active member of the association of Slovak electro-technical industry “Združenie elektrotechnickeho priemyslu SR“, ZEP. The association is very active especially in the field of transfer of knowledge and innovations. We hope that with the help of the events organized by the association we will able to promote the results of the research obtained at the Institute. The Institute coordinates activities within the project of structural funds “Centre of competence for new materials, advanced technologies and power engineering”. The project includes 9 industrial partners

from Bratislava region and provide framework for stimulation of cooperation with local industry.
Research teams within the Institute are actually organised in research departments. The research departments present relatively independent unit, able to apply for projects on national and international level. However, practice shows that cumulative effort of several groups is needed to be successful on international level. This system was successful in the past and with slight modifications will be preserved also for the next period.
Thanks to promotion of the PhD study we have got more application in the last period. Selection of PhD students should be realised through competitive entry examinations. Using support for young scientists through PhD and post-doc grants (Schwartz Fund at the SAS, Maria Curie training fellowships, APVV projects for young scientists) we will try to attract young researchers. Exploration of the skills, deep knowledge and broad ideas of older experienced scientists should be transferred to young generation.
Our research results will be open to international as well as to internal comparison and competition. Strong tendency to internal competition present at the Institute up to now will be preserved (see publication and citation output widely accessible on institute web pages, seminars of invited experts, etc.).
The Institute organizes each year internal evaluation of research activity of scientific departments. During the evaluation seminar subject of the research of particular department is open for discussion. Lot of interesting ideas emerged in the discussions during these seminars. Finally, research activity of individual researches is evaluated once per year in order to evaluate their individual contribution. We believe that through maintaining internal competitiveness we will be able fulfil objectives on national as well as on international scale.

Time schedule of the applications of proposed strategies

Most of the proposed strategies should be applied continuously during the whole period of the next four years. These measures include improvement of international relations, cooperation with local industry, and education of young researchers. However, some activities should be applied in defined time framework. For these activities the next period can be divided in two main parts:

2012-2013: Procuring of final list of equipments necessary for further technological development, implementation of new equipments in research projects

2014-2015: Application of new infrastructure in research projects, improvement of the Institute position in local and international environment.

## *III. Partial indicators of the main activities:*

### 1. Research output

**i. List of the selected publications documenting the most important results of basic research. Total number of publications in the whole assessed period should not exceed the average number of the research employees**

2007

[1] CAMBEL, Vladimír - ŠOLTÝS, Ján. The role of surface-layer conductivity in local anodic oxidation by AFM tip. In *Journal of Applied Physics*, 2007, vol. 102, art.no. 074315. (2.320 – IF2006).

[2] ČIČO, Karol - KUZMÍK, Ján - GREGUŠOVÁ, Dagmar - STOKLAS, Roman - LALINSKÝ, Tibor - GEORGAKILAS, A. - POGANY, Dionýz - FRÖHLICH, Karol. Optimization and performance of $Al_2O_3$/GaN metal-oxide-semiconductor structures. In *Microelectronic Reliability*, 2007, vol. 47, p. 790-793. (0. 820 – IF2006).

[3] ŠOLTÝS, Ján - CAMBEL, Vladimír - KÚDELA, Róbert - ELIÁŠ, Peter. Study into the shape of oxide lines formed by LAO – influence an oxidized material. In *Surface Science*, 2007, vol. 601, p. 2876-2880. (1.880 – IF2006).

2008

[4] FRÖHLICH, Karol - ŤAPAJNA, Milan - ROSOVÁ, Alica - DOBROČKA, Edmund - HUŠEKOVÁ, Kristína - AARIK, J. - AIDLA, A. Growth of high-dielectric-constant $TiO_2$ films in capacitors with $RuO_2$ electrodes. In Electrochemical and Solid State Letters. ISSN 1099-0062, 2008, vol. 11, p. G19-G21. (2.109 - IF2007).

[5] HOLÚBEK, Tomáš - KOVÁČ, Pavol - HUŠEK, Imrich. Relation between current transfer length and stability of Fe/ $MgB_2$ and Fe/Nb/$MgB_2$ conductors. In Acta Physica Polonica A. ISSN 058-4246. A, 2008, vol. 113, p. 367-370. (0.340 - IF2007).

[6] HOLÚBEK, Tomáš - KOVÁČ, Pavol - TAKÁCS, Silvester - HUŠEK, Imrich - MELIŠEK, Tibor. Current sharing and the stability of composite $MgB_2$ superconductors. In Superconductor Science and Technology. ISSN 0953-2048, 2008, vol. 21, art. no. 065013. (2.580 - IF2007).

[7] KOVÁČ, Pavol - BIRAJDAR, B. - HUŠEK, Imrich - HOLÚBEK, Tomáš - EIBL, O. Stabilized in situ rectangular $MgB_2$ wires: the effect of B purity and sheath materials. In Superconductor Science and Technology. ISSN 0953-2048, 2008, vol. 21, art. no. 045011. (2.580 - IF2007).

[8] KOVÁČ, Pavol - HUŠEK, Imrich - DOBROČKA, Edmund - MELIŠEK, Tibor - HAESSLER, W. - HERRMANN, M. $MgB_2$ tapes made of mechanically alloyed precursor powder in different metallic sheaths. In Superconductor Science and Technology. ISSN 0953-2048, 2008, vol. 21, p. 015004. (2.580 - IF2007).

[9] KOVÁČ, Pavol - PACHLA, W. - HUŠEK, Imrich - KULCZYK, M. - MELIŠEK, Tibor - HOLÚBEK, Tomáš - DIDUSZKO, R. - REISSNER, M. Multicore $MgB_2$ wires made by hydrostatic extrusion. In Physica C. 2008, vol. 468, p. 2356- 2360. (1.110 – IF2007).

[10] PARDO, Enric. Modeling of coated conductor pancake coils with a large number of turns. In Superconductor Science and Technology. ISSN 0953-2048, 2008, vol. 21, art. no. 065014. (2.580 - IF2007).

2009

[11] GENDIAR, Andrej - KRČMÁR, Roman - NISHINO, T. Spherical deformation for one-dimensional quantum systems. In Progress Theoretical Physics, 2009, vol. 122, p. 953-967. (1.661 - IF2008).

[12] GENDIAR, Andrej - KRČMÁR, Roman - WEYRAUCH, M. Large system asymplttics of persistent currents in mesoscopic quantum rings. In Physical Review B, 2009, vol. 79, art. no. 205118. (3.322 - IF2008).

[13] HUŠEK, Imrich - KOVÁČ, Pavol - MELIŠEK, Tibor - KOPERA, Ľubomír. Transport current densities of $MgB_2$ wires, cable and continually. In Cryogenics, 2009, vol. 49, p. 366-370. (0.915 - IF2008).

[14] ŠOUC, Ján - PARDO, Enric - VOJENČIAK, Michal - GÖMÖRY, Fedor. Theoretical and experimental study of AC loss in high temperature superconductor single pancake coils. In Superconductor Science and Technology, 2009, vol. 22, art. no. 015006. (1.847 - IF2008).

[15] MOŠKO, Martin - NÉMETH, Radoslav - KRČMÁR, Roman - INDLEKOFER, K.M. Luttinger liquid and persistent current in a continuous mesoscopic ring with a weak link. In Physical Review B, 2009, vol. 79, art. no. 245323. (3.322 - IF2008).

[16] ŤAPAJNA, Milan - KUZMÍK, Ján - ČIČO, Karol - POGANY, D. - POZZOVIVO, G. - STRASSER, G. - ABERMANN, S. - BERTAGNOLLI, E. - CARLIN, J.-F. - GRANDJEAN, N. - FRÖHLICH, Karol. Interface states and trapping effects in $Al_2O_3$- and $ZrO_2$/InAlN/AlN/GaN metal-oxide-semiconductor heterostructures. In Japanese Journal of Applied Physics, 2009, vol. 48, art. no. 090201. (1.309 -IF2008).

[17] ŤAPAJNA, Milan - ČIČO, Karol - KUZMÍK, Ján - POGANY, D. - POZZOVIVO, G. - STRASSER, G. - CARLIN, J.-F. - GRANDJEAN, N. - FRÖHLICH, Karol. Thermally induced voltage shift in capacitance-voltage characteristics and its relation to oxide/semiconductor interface states in Ni/$Al_2O_3$/InAlN/GaN heterostructures. In Semiconductor Science and Technology, 2009, vol. 24, art. no. 035008. (1.434 -IF2008).

2010

[18] NOVÁK, Jozef - VÁVRA, Ivo - KRIŽANOVÁ, Zuzana - HASENÖHRL, Stanislav - ŠOLTÝS, Ján - REIFFERS, Marián - ŠTRICHOVANEC, Pavol. Dependence of Curie temperature on the surface strain in InMnAs epitaxial structures. In Applied Surface Science, 2010, vol. 256, no. 18, p. 5672-5675. (1.616 - IF2009).

[19] GREGUŠOVÁ, Dagmar - STOKLAS, Roman - MIZUE, Ch. - HORI, Y. - NOVÁK, Jozef - HASHIZUME, T. - KORDOŠ, Peter. Trap states in AlGaN/GaN metal-oxide-semiconductor structures with $Al_2O_3$ prepared by atomic layer deposition. In Journal of Applied Physics, 2010, vol. 107, art. no. 106104. (2.072 -IF2009).

2011

[20] FEILHAUER, Juraj - MOŠKO, Martin. Conductance and persistent current in quasi-one-dimensional systems with grain boundaries: Effects of the strongly reflecting and columnar grains. In Physical Review B, 2011, vol. 84, art. no. 085454. (3.772 - IF2010).

[21] FEILHAUER, Juraj - MOŠKO, Martin. Quantum and Boltzmann transport in a quasi-one-dimensional wire with rough edges. In Physical Review B, 2011, vol. 83, art. no. 245328. (3.772 - IF2010).

[22] FERNANDES, H. - GÖMÖRY, Fedor - DELLA CORTE, A. - CELENTANO, G. - ŠOUC, Ján - SILVA, C. - CARVALHO, I. - GOMES, R. - DI ZENOBIO, A. - MESSINA, G. Toroidal high temperature superconducting coils for ISTTOK. In Fusion Engineering and Design, 2011, vol. 86, p. 1458-1461. (1.143 - IF2010).

[23] PARDO, Enric - VOJENČIAK, Michal - GÖMÖRY, Fedor - ŠOUC, Ján. Low-magnetic-field dependence and anisotropy od the critical current density in coated conductors. In Superconductor Science and Technology, 2011, vol. 24, art. no. 065007. (2.402 - IF2010).

[24] VOJENČIAK, Michal - GRILLI, F. - TERZIEVA, S. - GOLDACKER, W. - KOVÁČOVÁ, M. - KLING, A. Effect of self-field on the current distribution in Roebel-

assembled coated conductor cables. In Superconductor Science and Technology, 2011, vol. 24, art. no. 095002. (2.402 - IF2010).

**ii. List of the selected publications documenting the most important results of applied research**

[1] POLÁK, Milan - MOZOLA, Pavol. A flat cable with resistively joined YBCO stripes. In Superconductor Science and Technology, 2010, vol. 23, art. no. 025025. (2.694 - IF2009).

[1] VANKO, Gabriel - LALINSKÝ, Tibor - HAŠČÍK, Štefan - RÝGER, I. - MOZOLOVÁ, Želmíra - ŠKRINIAROVÁ, J. - TOMÁŠKA, M. - KOSTIČ, Ivan - VINCZE, A. Impact of $SF_6$ plasma treatment on performance of AlGaN/GaN HEMT. In Vacuum, 2009, vol. 84, p. 235-237. (1.114 - IF2008)..

**iii. List of monographs/books published abroad**

**iv. List of monographs/books published in Slovakia**

**v. List of other scientific outputs specifically important for the Organisation (normalization, standardization, maps, etc.)**

[1] Biennial Report IEE SAS 2007 – 2008. Eds. M. Španková et al. Bratislava: IEE SAS 2009. 119s.

[2] Biennial Report IEE SAS 2009 –2010. Eds. B. Zaťko et al. Bratislava: IEE SAS 2011. 114.

**vi. Table of research outputs**

*Table **Research outputs** shows research outputs in number of specified entries; these entries are then divided by FTE employees with a university degree (from Tab. Research staff) for all Organisation at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).*

*(and the name of research organisations appears in the list of author)*

| Research outputs | 2007 | | | 2008 | | | 2009 | | | 2010 | | | 2011 | | | 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 | No. / FTE | No. / salary budget | number | averaged number per year | av. No. / FTE | av. No. / salary budget |
| chapters in monographs, books published abroad | 0 | 0,000 | 0,00 | 3 | 0,055 | 3,32 | 0 | 0,000 | 0,00 | 0 | 0,000 | 0,00 | 0 | 0,000 | 0,00 | 3 | 0,6 | 0,010 | 0,65 |
| chapters in monographs, books published in Slovakia | 0 | 0,000 | 0,00 | 0 | 0,000 | 0,00 | 0 | 0,000 | 0,00 | 0 | 0,000 | 0,00 | 1 | 0,017 | 1,08 | 1 | 0,2 | 0,003 | 0,22 |
| CC publications | 82 | 1,405 | 96,51 | 57 | 1,036 | 63,16 | 59 | 1,004 | 62,23 | 50 | 0,786 | 51,66 | 79 | 1,304 | 85,37 | 327 | 65,4 | 1,099 | 71,19 |
| scientific publications indexed by other databases (specify) | 3 | 0,051 | 3,53 | 8 | 0,145 | 8,86 | 12 | 0,204 | 12,66 | 19 | 0,299 | 19,63 | 7 | 0,116 | 7,56 | 49 | 9,8 | 0,165 | 10,67 |
| scientific publications in other journals | 5 | 0,086 | 5,88 | 4 | 0,073 | 4,43 | 2 | 0,034 | 2,11 | 6 | 0,094 | 6,20 | 5 | 0,083 | 5,40 | 22 | 4,4 | 0,074 | 4,79 |
| publications in proc. of international scientific conferences | 11 | 0,188 | 12,95 | 31 | 0,563 | 34,35 | 5 | 0,085 | 5,27 | 26 | 0,409 | 26,86 | 8 | 0,132 | 8,65 | 81 | 16,2 | 0,272 | 17,63 |
| publications in proc. of nat. scientific conferences | 13 | 0,223 | 15,30 | 17 | 0,309 | 18,84 | 19 | 0,323 | 20,04 | 10 | 0,157 | 10,33 | 15 | 0,248 | 16,21 | 74 | 14,8 | 0,249 | 16,11 |
| active participations at international conferences | 58 | 0,994 | 68,26 | 60 | 1,091 | 66,48 | 58 | 0,987 | 61,17 | 93 | 1,462 | 96,08 | 81 | 1,337 | 87,53 | 350 | 70,0 | 1,176 | 76,19 |
| active participations at national conferences | 12 | 0,206 | 14,12 | 9 | 0,164 | 9,97 | 20 | 0,340 | 21,09 | 10 | 0,157 | 10,33 | 16 | 0,264 | 17,29 | 67 | 13,4 | 0,225 | 14,59 |

### vii. List of registered patents

2008

[1] CHROMIK, Štefan, a VINCENC OBOŇA, Jozef: Spôsob tvarovania tenkých vrstiev v kryotechnike s použitím fullerénu $C_{60}$. ÚPV SR PV 286586.

[2] CHROMIK, Štefan, KOSTIČ, Ivan a VINCENC OBOŇA, Jozef: Spôsob tvarovania submikrometrových štruktúr v kryotechnike s použitím fullerénu $C_{60}$. ÚPV SR PV 286519.

2010

[3] BARNES, Paul N., POLÁK, Milan, and VARANASI, Chakrapani: AC-tolerant HTS coated conductor with transposed filaments. US Patent No. 7,756,557.

[4] FERRARI, C. and KORYTÁR, D.: Monocromatore monolitico per difrattometria X ad alta risoluzione e ad alta efficienza. Brevetto No. 0000265480, Roma 2010.

[5] UŠÁK, Pavol, MOZOLA, Pavol a POLÁK, Milan: Spôsob mapovania vybranej zložky vlastného magnetického poľa kábla. ÚPV SR PV 287557.

**viii. Supplementary information and/or comments on the scientific output of the Organisation**

## 2. Responses to the scientific output

*Table **Citations** shows specified responses to the scientific outputs; these entries are then divided by the FTE employees with a university degree (from Tab. Research staff) for all Organisation at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).*

| Citations | 2006 | | | 2007 | | | 2008 | | | 2009 | | | 2010 | | | 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 | No. / FTE | No. / salary budget | number | averaged number per year | av. No. / FTE | av. No. / salary budget |
| Web of Science | 393 | 6,7 | 462,5 | 552 | 10,0 | 611,6 | 524 | 8,9 | 552,7 | 620 | 9,7 | 640,5 | 627 | 10,3 | 677,6 | 2716 | 543,2 | 9,1 | 591,3 |
| (specify Database 1) | 46 | 0,8 | 54,1 | 30 | 0,5 | 33,2 | 47 | 0,8 | 49,6 | 62 | 1,0 | 64,1 | 23 | 0,4 | 24,9 | 208 | 41,6 | 0,7 | 45,3 |
| (specify Database 1) | 0 | 0,0 | 0,0 | 0 | 0,0 | 0,0 | 0 | 0,0 | 0,0 | 0 | 0,0 | 0,0 | 0 | 0,0 | 0,0 | 0 | 0,0 | 0,0 | 0,0 |
| in monographs, conf. proceedings and other publications abroad | 23 | 0,4 | 27,1 | 38 | 0,7 | 42,1 | 25 | 0,4 | 26,4 | 13 | 0,2 | 13,4 | 5 | 0,1 | 5,4 | 104 | 20,8 | 0,3 | 22,6 |
| in monographs, conf. proceedings and other publications in Slovakia | 0 | 0,0 | 0,0 | 0 | 0,0 | 0,0 | 0 | 0,0 | 0,0 | 8 | 0,1 | 8,3 | 2 | 0,03 | 2,2 | 10 | 2,0 | 0,03 | 2,2 |

**i. List of 10 top-cited publications from staff members since the establishment of the Organisation up to 2010 and number of their citations in the period 2006 - 2010**

[1.] **Kuzmík**, **J**.: Power electronics on InAlN/(In)GaN: prospect for a record performance, IEEE Electron Devices Letters 22 (2001) 510-512. **86 SCI**

[2.] **Gömöry**, **F**.: Characterization of high-temperature superconductors by AC susceptibility measurement, Supercond. Sci Technol. 10 (1997) 523. **60 SCI**

[3.] Glowacki, B.A., **Majoros**, **M**., Vickers, M., Evetts, J.E., Shi, Y., and McDougall, I.: Superconductivity of powder-in-tube $MgB_2$ wires, Supercond. Sci & Techn. 14 (2001) 193-199. **55 SCI**

[4.] **Dobročka**, **E**. and **Osvald**, **J**.: Influence of barrier height distribution on the parameters of Schottky diodes, Applied Phys. Lett. 65 (1994) 575. **54 SCI**

[5.] **Plecenik**, **A**., Grajcar, M., **Beňačka**, **Š**., Seidel, P., and Pfuch, A.: Surface characterization of high-$T_c$ superconductors using $YBa_2Cu_3O_x$/Au and $Bi_2Sr_2CaCu_2O_y$/Au point contacts, Phys. Review B 49 (1994) 10 016. **43 SCI**

[6.] **Osvald, J**. and Horváth, Zs.J.: Theoretical study of the temperature dependence of electrical characteristics of Schottky diodes with an inverse near-surface layer, Applied Surface Sci 234 (2004) 349-354. **41 SCI**

[7.] Karapetrov, G., **Fedor**, **J**., Iavaronne, M., Rosenmann, D., and Kwok, W.K.: Direct observation of geometrical phase transitions in mesoscopic superconductors by scanning tunneling microscopy, Phys. Rev. Lett. 95 (2005) 167002. **32 SCI**

[8.] **Kuzmík**, **J**., Javorka, P., Alam, A., Marso, M., Heuken, M., and Kordos, P.: Determination of channel temperature in AlGaN/GaN HEMTs grown on sapphire and silicon substrates using DC characterization method, IEEE Trans. on Electron Devices 49 (2002) 1496-1498. **30 SCI**

[9.] Meneghesso, G., Rampazzo, F., **Kordoš**, **P**., Verzellesi, G., and Zanoni, E.: Current-collapse and hot-electron-reliability characteristics of unpassivated GaN/AlGaN/GaN HEMTs, IEEE Trans. Electron Devices 53 (2006) 2932. **29 SCI**

[10.] Hotový, I., **Huran**, **J**., Spiess, L., **Haščík**, **Š**., and Rehacek, V.: Preparation of nickel oxide films for gas sensors applications, Sensors and Actuators B 57 (1999) 147-152. **26 SCI**

**ii. List of 10 top-cited publications from staff members published 2000 - 2010 and number of their citations in the period 2006 - 2010**

[1] **Kuzmík**, **J**.: Power electronics on InAlN/(In)GaN: prospect for a record performance, IEEE Electron Devices Letters 22 (2001) 510-512. **86 SCI**

[2] Glowacki, B.A., **Majoros**, **M**., Vickers, M., Evetts, J.E., Shi, Y., and McDougall, I.: Superconductivity of powder-in-tube $MgB_2$ wires, Supercond. Sci & Techn. 14 (2001) 193-199. **55 SCI**

[3] **Osvald, J**. and Horváth, Zs.J.: Theoretical study of the temperature dependence of electrical characteristics of Schottky diodes with an inverse near-surface layer, Applied Surface Sci 234 (2004) 349-354. **41 SCI**

[4] Karapetrov, G., **Fedor**, **J**., Iavaronne, M., Rosenmann, D., and Kwok, W.K.: Direct observation of geometrical phase transitions in mesoscopic superconductors by scanning tunneling microscopy, Phys. Rev. Lett. 95 (2005) 167002. **32 SCI**

[5] **Kuzmik**, **J**., Javorka, P., Alam, A., Marso, M., Heuken, M., and Kordos, P.: Determination of channel temperature in AlGaN/GaN HEMTs grown on sapphire and silicon substrates using DC characterization method, IEEE Trans. on Electron Devices 49 (2002) 1496-1498. **30 SCI**

[6] Meneghesso, G., Rampazzo, F., **Kordoš**, **P**., Verzellesi, G., and Zanoni, E.: Current-collapse and hot-electron-reliability characteristics of unpassivated GaN/AlGaN/GaN HEMTs, IEEE Trans. Electron Devices 53 (2006) 2932. **29 SCI**

[7] **Kuzmik**, **J**.: InAlN/(In)GaN high electron mobility transistors: some aspects of the quantum well heterostructure proposal, Semicond. Sci Techn. 17 (2002) 540-544. **25 SCI**

[8] Marso, M., Heidelberg, G., Indlekofer, K.M., Bernat, J., Fox, A., **Kordoš**, **P**., and Lüth, H.: Origin of improved RF performance of AlGaN/GaN MOSHFETs compared to HFETs, IEEE Trans. Electron Dev. 53 (2006) 1517-1523. **22 SCI**

[9] **Osvald, J**.: Series resistance influence on intersecting behaviour of inhomogeneous Schottky diodes *I-V* curves, Solid-State Electr. 50 (2006) 228-231. **21 SCI**

[10] **Kováč**, **P**., Hušek, I., Melišek, T., Grivel, J.C., Pachla, W., Štrbík, V., Diduszko, R., Homeyer, J., and Andersen, N.H.: The role of MgO content in *ex situ* $MgB_2$ wires, Supercond. Sci Technol. 17 (2004) L41-L46. **19 SCI**

**iii. List of top-cited authors from the Organisation (at most 10 % of the research employees) and their number of citations in the period 2006 - 2010**

[1] Ing. Pavol Kováč, DrSc. – 378 SCI

[2] Ing. Ján Kuzmík, DrSc. - 283 SCI

[3] Ing. Fedor Gömöry, DrSc. – 267 SCI

[4] Ing. Jozef Osvald, DrSc. – 259 SCI

[5] doc. Ing. Peter Kordoš - 238 SCI

[6] Ing. Karol Fröhlich, DrSc. – 224 SCI

**iv. Supplementary information and/or comments on responses to the scientific output of the Organisation**

## 3. Research status of the Organisation in the international and national context

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

**i. List of the most important research activities documenting international importance of the research performed by the Organisation, incl. major projects (details of projects should be supplied under Indicator 4). Provide the arguments why the selected projects are particularly important and represent the international position of the Organisation ).**

As it follows from the Institute's successful participation in the EU Framework Programme and from the list of the most cited publications, the most promising and successful research topics the Institute worked on between 2009 and 2010 were the technology of GaN-based devices and applied superconductivity. In both fields the groups from the Institute participated in the projects of the EU Framework Programme and belong to the top EU research teams. The major research projects within the assessed period include:

[1] GaN-based normally-off high power switching transistor for efficient power converters - HiPoSwitch, 7$^{th}$ FP project
[2] Development and field testing of an efficient YBCO Coated Conductor based Fault Current Limiter for Operation in Electricity Networks - ECCOFLOW, 7$^{th}$ FP project
[3] Materials for Robust Gallium Nitride - MORGaN, 7$^{th}$ FP project
[4] Nano-Engineering Superconductors for Power Applications – NESPA, 6$^{th}$ FP project
[5] Superconducting coated conductor cable – SUPER3C, 6$^{th}$ FP project
[6] Nano- and micro-scale engineering of higher-performance $MgB_2$ composite superconductors for macro-scale applications – HIPERMAG, 6$^{th}$ FP project

[7] InAlN/(In)GaN Heterostructure Technology for Ultra-high Power Microwave Transistor – ULTRAGAN, 6th FP project

**ii. List of international conferences (co-) organised by the Organisation**

[1] 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[2] 7th Autumn School on X-ray scattering from surfaces and thin layers, Oct. 4-10, 2007, Smolenice (FMP UK Praha, Univ. of Siegen)
[3] NANOVED 2007, Nov. 10 – 14 2007, Bratislava (IMMM SAS, IP SAS)
[4] 1st NESPA Training Course on Advanced Electrical Characterization of Superconductors, April 7-10, 2008, Bratislava
[5] 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[6] Mikroskopia 2009, March 25 – 27, 2009, Stará Lesná (CSMS)
[7] 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava
[8] 13th Joint Vacuum Conference JVC13, June 20 – 24, 2010, Strbske pleso (SVS)
[9] 8thAdvanced Semiconductor Devices and Microsystems ASDAM'10, Oct. 25-27, 2010, Smolenice (FEI STU)
[10] 8th Autumn School on X-ray Scattering from Surfaces and Thin Layers, 4.-7. October 2011, Smolenice, (FMP UK Praha, Univ. of Siegen)

**iii. List of international journals edited/published by the Organisation**

[1] Journal of Electrical Engineering (FEI STU)

**iv. List of edited proceedings from international scientific conferences and other proceedings**

[1] 12th European Workshop on Metalorganic Vapour Phase Epitaxy: extended abstracts. Bratislava: IEE SAS, 2007. 366 p.
[2] HAŠČÍK, Štefan (ed.) - OSVALD, Jozef (ed.). *ASDAM 2008 : conference proceeding of the Seventh International Conference on Advanced Semiconductor Devices and Microsystems. Smolenice Castle*. Piscataway: IEEE, 2008. ISBN 978-1-4244-2325-5.
[3] WoDiM 2010: 16th Workshop on Dielectric in Microelectronics. Book of Abstracts. Bratislava: IEE SAS, 2010. 153 p.

- **National position of the Organisation**

**i. List of selected most important national projects (provide the arguments why the selected projects are particularly important and represent the international position of the Organisation)**

[1] Center of Excellence for New Technologies in Electrical Engineering, ASFEU
[2] Center of Excellence for New Technologies in Electrical Engineering II, ASFEU
[3] Center of competence for new materials, advanced technologies and power engineering, ASFEU
[4] Thin oxide films for GaN heterostructures, APVV
[5] Selected topics from X-ray technologies, APVV
[6] Advanced filamentary composite $MgB_2$ superconductors, APVV

[7] Carbon nanocomposites for chemical sensing, APVV

[8] Advanced MEMS chemical sensors for extreme conditions, APVV

[9] Structure metal-insulator-metal for nanoscale DRAM memories, APVV

[10] Technology and characterization of modern semiconductor thin films for microelectronics and optoelectronics, APVV

[11] MOS HFET tranzistory na báze III-V polovodičov pre vysokoteplotné aplikácie, APVV

[12] Metal-oxide-metal structures for resistive switching based memory cells, APVV

[13] Fine-filamentary superconducting $MgB_2$ wires for steady and alternating current windings, APVV

[14] Towards next generation of III-N high-electron-mobility transistors, APVV

[15] Advanced piezoelectric MEMS pressure sensors, APVV

[16] Growth of nanowires for photovoltaic applications, APVV

**ii. List of national scientific conferences (co)-organised by the Organisation**

[1] Seminar CENG, 11-12 Oct., 2007, Smolenice

[2] Seminar CENG, 11-12 Sept., 2008, Smolenice

**iii. List of national journals published by the Organisation**

**iv. List of edited proceedings of national scientific conferences/events**

- **International/European position of the individual researchers**

**i. List of invited/keynote presentations at international conferences, documented by an invitation letter or programme**

[1] Gömöry, F., Vojenčiak, M., Pardo, E., and Šouc, J.: Influence of ferromagnetic substrate on the properties of coated conductor. In: Inter. Workshop on Coated Conductors for Applications - CCA 2008. Houston 2008.

[2] Gömöry, F., Vojenčiak, M., Pardo, E., and Šouc, J.: Magnetic flux penetration and AC loss in a composite superconducting wire with ferromagnetic parts. In: Inter. Conference on Superconductivity and Magnetism - ICSM 2008. Side (Turecko) 2008.

[3] Gömöry, F.: AC loss in superconducting wires and cables. In: CERN 2008.

[4] Chromik, Š.: Perovskite YBCO and LSMO films on advanced semiconducting substrates.In: 6th Inter. Conf. Solid State Surfaces and Interfaces 2008, Smolenice.

[5] Kuzmik, J.: Advances and prospects of InAlN/GaN HEMTs. In: 17th Inter. Workshop on Heterostructure Technology. Venice 2008.

[6] Dubecký, F.: Anomalous charge current transport in semi-insulating GaAs with a new contact metallization: Influence of 2DEG formed at the M-S interface. In: Progress in Applied Surface, Interface and Thin Film Sci 2009. Florencia 2009.

[7] Chromik, Š.: Influence of SiC buffer layer on electrical and magnetic properties of $MgB_2$ films grown on Si substrate. In: Progress in Applied Surface, Interface and Thin Film Sci 2009. Florencia 2009.

[8] Gömöry, F., Vojenčiak, M., Pardo, E., Solovyov, M., and Šouc, J.: AC losses in coated conductors. In: 9th European Conf. on Applied Superconductivity - EUCAS 09. Dresden 2009.

[9] Gömöry, F., Vojenčiak, M., Safran, S., Çiçek, Ö., and Šouc, J.: AC losses of HTSC tapes. In: Inter. Symposium on Superconductivity. Tsukuba 2009.

[10] Gömöry, F.: AC losses of CC tape on bilayer ferromagnetic substrate. In: Inter. Workshop on Coated Conductors for Applications. Barcelona 2009.
[11] Dubecký, F., Hubík, P., Kindl, D., Oswald, J., Zaťko, B., Boháček, P., Gombia, E., and Nečas, V.: Novel concept of the surface barrier electrode: application to semi-insulating GaAs radiation detector. In: 2010 Nuclear Sci Symposium Medical Imaging Conf. Knoxville (USA) 2010.
[12] Gömöry, F. and Solovyov, M.: Numerical simulation of magnetic flux penetration and AC loss in HTSC coated conductor tapes. In: Inter. Conf. on Superconduvity and Magnetism - ICSM 2010. Antalya 2010.
[13] Chromik, Š.: The role of the substrate and interface on the structural and electrical properties of films for cryoelectronics. In: SSSI 2010. 7th Inter. Conf. of the Solid State Surfaces and Interfaces conferences. Smolenice 2010.
[14] Chromik, Š.: The influence of substrate and interface on the structural and electrical properties of substrate properties of the superconducting films. In: 13th Joint Vacuum Conf.. Štrbské Pleso 2010.
[15] Kováč, P., Hušek, I., Melišek, T., and Kopera, L.: Wires and cables from $MgB_2$. In: Inter. Conf. on Superconduvity and Magnetism - ICSM 2010. Antalya 2010.
[16] Kováč, P.: General overview of superconducting materials. In: Superconductivity in Energy Technology Applications. Tampere 2010.
[17] Kuzmík, J.: Technology, properties and characterization of InAlN/GaN HEMTs. In: 2010 International RCIQE/CREST Joint Workshop. Hokkaido 2010.
[18] Novák, J.: Influence of the wetting layer thickness on the formation of InMnAs dots. In: SSSI 2010. In: 7th Inter. Conf. of the Solid State Surfaces and Interfaces Conf. Smolenice 2010.
[19] Novák, J.: Role of growth mode in the formation of magnetic properties of InMnAs grown by MOVPE. In: 16th Inter. Conf. Crystal Growth/14th Inter. Conf. Vapor Growth Epitaxy (ICCG-16/ICVGE-14). Beijing, China 2010.
[20] Takács, S.: Der mühselige und abenteuerliche Weg der Forschung und des Forschers – Supraleitung und Fusion Beispiel. In: 8. Alumni-Tag der Physikalisch-Astronomischen Fakultät mit feierlicher Zeugnisübergabe. Jena 2010.
[21] Fröhlich, K.: Sub 0.5 nm EOT capacitors for DRAM applications. In: Workshop on Micro and Nano-Electronics 2DAYs. Roma 2011.
[22] Kordoš, P.: Preparation and properties of GaN-based MOSHEFTs. 35th Workshop on Compound Semicond. Devices and Integrated Circuits. Catania 2011.
[23] Kuzmík, J.: InAlN/GaN HEMTs: recent progress and challenges for the future. 2011 Inter. Conf. Solid State Devices Materials (SSDM 2011). Nagoya Japan 2011.
[24] Lobotka, P.:Conducting polymers and their use in Sensorics and Electronics. 13th Inter. Conf. – School „Advanced Materials and Technologies“. Palanga (Lithuania) 2011.
[25] Vávra, I.:Properties of metallic nanoparticles and nanocomposites prepared by vacuum technologies. 2nd Nanomaterials and Nanotechnology Meeting “Nano Ostrava 2011“. Ostrava 2011.
[26] Novák, J.: Nanorods and nanowires for photovoltaic applications. 17. konf. slovenských a českých fyzikov. Žilina 2011.

**ii. List of employees who served as members of the organising and/or programme committees for international conferences**

[1] Ing. M. Polák, DrSc. – Inter. Organizing Comm. 20th Inter. Conf. on Magnet Technology, Philadelphia USA, August 27 - 31, 2007
[2] Ing. F. Dubecký, CSc. - Inter. Advisory Comm. SIMC XIV Semi-insulating III-V Materials Conf., Arkansas, May 15-20, 2007
[3] doc. Ing. J. Novák, DrSc. - Chair 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava

[4] Ing. P. Eliáš - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[5] RNDr. D. Gregušová, CSc. - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[6] PhDr. A. Gömöryová - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[7] Ing. S. Hasenöhrl - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[8] Ing. R. Kúdela, CSc. - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[9] Ing. J. Martaus, PhD. - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[10] Ing. M. Morvic, CSc. - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[11] Ing. J. Šoltýs, PhD. - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[12] Ing. P. Štrichovanec, PhD. - Organizing Comm. 12th European Workshop on Metalorganic Vapour Phase Epitaxy - EW-MOVPE 2007, June 3 – 6, 2007, Bratislava
[13] RNDr. D. Korytár, CSc. – Organizer 7th Autumn School on X-ray scattering from surfaces and thin layers, Oct. 4-10, 2007, Smolenice
[14] Ing. I. Vávra, CSc. – Inter. Advisory Board Inter. Inter. Conf. NANOVED 2007, Bratislava, Nov 12-15, 2007
[15] Ing. P. Lobotka, CSc. – Inter. Advisory Board Inter. Inter. Conf. NANOVED 2007, Bratislava, Nov 12-15, 2007
[16] doc. Ing. J. Novák, DrSc. - Inter. Organizing Comm. 14th Inter. Conf. of Metalorganic Vapor Phase Epitaxy IC-MOVPE 2008, Metz, June 1-6, 2008
[17] doc. Ing. F. Gömöry, DrSc. - Chair 1st NESPA Training Course on Advanced Electrical Characterization of Superconductors, April 7-10, 2008, Bratislava
[18] doc. Ing. P. Kordoš, DrSc. - Chair 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[19] Ing. F. Dubecký, CSc. - Inter. Organizing Comm. 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[20] Ing. T. Lalinský, DrSc. - Inter. Organizing Comm. 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[21] Ing. J. Osvald, DrSc. - Inter. Organizing Comm. 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[22] J. Baronová - Organizing Comm. 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[23] M. Grujbár - Organizing Comm. 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[24] RNDr. Š. Haščík, PhD. - Organizing Comm. 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[25] Ing. J. Huran, CSc. - Organizing Comm. 7thAdvanced Semiconductor Devices and Microsystems ASDAM'08, Oct. 16-18, 2008, Smolenice
[26] Ing. Milan Polák, DrSc. - Inter. Organizing Comm. 21st Inter. Conf. on Magnet Technology, Hefei, Anhui, China, Oct. 18 - 23, 2009
[27] Ing. F. Dubecký, CSc. - Inter. Advisory Comm. SIMC XV Semi-insulating III-V Materials Conf., Vilnius, June 15-19 2009
[28] doc. Ing. F. Gömöry, DrSc. - Inter. Advisory Comm. 9th European Conference on Applied Superconductivity EUCAS 2009, Dresden, Sept. 13-17, 2009
[29] doc. Ing. P. Kordoš, DrSc. - Inter. Organizing Comm. 18th European Workshop on Heterostructure Technology, Gunzburg/Ulm Nov.02-04, 2009
[30] doc. Ing. J. Novák, DrSc. - Steering Comm. 18th European Workshop on Heterostructure Technology, Gunzburg/Ulm Nov.02-04, 2009

[31] Ing. I. Vávra, CSc. - Organizing Comm. Mikroskopia 2009, March 25 – 27, 2009, Stará Lesná
[32] Ing. Z. Križanová - Organizing Comm. Mikroskopia 2009, March 25 – 27, 2009, Stará Lesná
[33] J. Ryzá - Organizing Comm. Mikroskopia 2009, March 25 – 27, 2009, Stará Lesná
[34] doc. Ing. F. Gömöry, DrSc. - Inter. Organizing Comm. 6th Inter. Conf. Science and Engineering of Novel Superconductors CIMTEC 2010, Montecatini Terme, June 13 -18, 2010
[35] doc. Ing. F. Gömöry, DrSc. - Inter. Advisory Comm. Applied Superconductivity Conf. 2010, Washington, Aug 1–6 2010.
[36] doc. Ing. F. Gömöry, DrSc. - Inter. Advisory Comm. Inter. Conf. on Superconductivity and Magnetism 2010, Antalya, April 25-30, 2010
[37] Ing. P. Kováč, DrSc. - Inter. Advisory Comm. Inter. Conf. on Superconductivity and Magnetism 2010, Antalya, April 25-30, 2010
[38] Ing. J. Kuzmík, DrSc. - Programme Comm. Inter. Workshop on Nitride Electronic - IWN 2010 Tampa, Florida, Sept. 19 – 24, 2010
[39] doc. Ing. J. Novák, DrSc. - Steering Comm. 19th European Workshop on Heterostructure Technology, Fodele, Oct. 18-20 2010
[40] Ing. D. Machajdík, CSc. – Inter. Sci Comm. VIII Inter. Conf. Ion Implantation and Other Applications of Ions and Electrons - ION 2010, Kazimierz Dolny, June 14-17 2010
[41] Ing. I. Vávra, CSc. - Organizing Comm. Inter. Conf. NANOVED & NANOTECH & TECHTRANSFER 2010, Bratislava, May 16-19, 2010
[42] Ing. Z. Križanová - Organizing Comm. Inter. Conf. NANOVED & NANOTECH & TECHTRANSFER 2010, Bratislava, May 16-19, 2010
[43] Ing. K. Fröhlich, DrSc. - Chair 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava
[44] Ing. K. Čičo, PhD. - Organizing Comm. 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava
[45] RNDr. E. Dobročka, CSc. - Organizing Comm. 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava
[46] PhDr. A. Gömöryová - Organizing Comm. 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava
[47] RNDr. D. Gregušová, CSc. - Organizing Comm. 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava
[48] Ing. B. Hudec - Organizing Comm. 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava
[49] Dr. G. Karapetrov - Organizing Comm. 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava.
[50] Mgr. M. Sojková, PhD. - Organizing Comm. 16th Workshop on Dielectric Materials, WoDiM 2010, June 28 – 30, 2010, Bratislava
[51] Ing. I. Vávra, CSc. - Organizing Comm. 13th Joint Vacuum Conference JVC13, June 20 – 24, 2010, Strbske pleso
[52] Ing. F. Dubecký, CSc. - Inter. Programme Comm. 8thAdvanced Semiconductor Devices and Microsystems ASDAM'10, Oct. 25-27, 2010, Smolenice
[53] Ing. K. Fröhlich, DrSc. - Inter. Programme Comm. 8thAdvanced Semiconductor Devices and Microsystems ASDAM'10, Oct. 25-27, 2010, Smolenice
[54] doc. Ing. P. Kordoš, DrSc. - Inter. Programme Comm. 8thAdvanced Semiconductor Devices and Microsystems ASDAM'10, Oct. 25-27, 2010, Smolenice
[55] Ing. T. Lalinský, DrSc. - Inter. Programme Comm. 8thAdvanced Semiconductor Devices and Microsystems ASDAM'10, Oct. 25-27, 2010, Smolenice
[56] Ing. J. Osvald, DrSc. - Inter. Programme Comm. 8thAdvanced Semiconductor Devices and Microsystems ASDAM'10, Oct. 25-27, 2010, Smolenice

[57] doc. Ing. J. Novák, DrSc. - Programme Comm. 14th European Workshop on Metal-Organic Vapour Phase Epitaxy Vroclav, June 5-8 2011
[58] doc. Ing. J. Novák, DrSc. - Programme Comm. 20th European workshop on Hetrostructure Technology, Lille, Nov 7-9, 2011
[59] Ing. M. Polák, DrSc. - Inter. Organizing Comm. 22th Inter. Conf. on Magnet Technology, Marseille, Sept 12-16 2011
[60] RNDr. D. Korytár, CSc. – Organizer 8th Autumn School on X-ray scattering from surfaces and thin layers, Oct. 4-7, 2011, Smolenice.

**iii. List of employees who served as members of important international scientific bodies (e.g. boards, committees, editorial boards of scientific journals)**

[1] Ing. František Dubecký, CSc., member of the board of OS Polovodiče pri JČ-SMF
[2] Ing. František Dubecký, CSc., member of editorial board of scientific journal World Journal of Radiology
[3] Ing. Štefan Chromik, DrSc., member of editorial board of scientific journal ICRN Cond. Matter Physics
[4] Ing. Fedor Gömöry, DrSc., member of Technical Advisory Panel of Fusion for Energy (European Union's Joint Undertaking for ITER)
[5] RNDr. Dušan Korytár, CSc., member of Comité Européen de Normalisation
[6] Ing. Tibor Lalinský, DrSc., member of editorial board of scientific journal Open Electrical and Electronic Engineering Journal
[7] Ing. Peter Lobotka, CSc., member of NMP European Commision
[8] Ing. Daniel Machajdík, CSc., member of the board of Československá mikroskopická spoločnosť
[9] Ing. Jozef Pitel, CSc., member of Fusion for Energy's Governing Board (European Union's Joint Undertaking for ITER)
[10] Ing. Alica Rosová, CSc., member of the board of Československá mikroskopická spoločnosť
[11] Ing. Ivo Vávra, CSc., member of the board of Československa mikroskopická spoločnosť

**iv. List of international scientific awards and distinctions**

[1] Ing. Karol Fröhlich, DrSc., Chevalier dans l´Ordre des Palmes Académiques (award of French government)

- **National position of the individual researchers**

**i. List of invited/keynote presentations at national conferences documented by an invitation letter or programme**

**ii. List of employees who served as members of organising and programme committees of national conferences**

**iii. List of employees serving in important national scientific bodies (e.g. boards, committees, editorial boards of scientific journals)**

[1] Doc. RNDr. Edmund Dobročka, CSc., member of the board of Jednota slovenských matematikov a fyzikov pri SAV, deputy chair (2007-2011)

[2] Ing. Karol Fröhlich, DrSc. Scientific council Fakulty of Mechatronics TNUAD (2007)

[3] Ing. Karol Fröhlich, DrSc. Scientific council of Slovak Metrological Institute (2011)

[4] Mgr. A. Gendiar, PhD executive editor of Acta Physica Slovaca (2007-2010)

[5] Doc. Ing. Fedor Gömöry, DrSc., member of SKVH - Commission of Ministry of Education SR (2010-2011)

[6] Doc. Ing. Fedor Gömöry, DrSc., member of Accreditation Commission of Ministry of Education SR, workgroup for electrical engineering and energy (2010-2011)

[7] Doc. Ing. P. Kordoš, DrSc, member of editorial board of Journal of Electrical Engineering (2007-2011)

[8] Ing. Peter Lobotka, CSc., member board of Slovak Physical Society (2007-2011)

[9] Ing. Daniel Machajdík, CSc., member of National Board for Cooperation with JINR Dubna (2007-2010)

[10] Doc. Ing. Jozef Novák, DrSc., Scientific council FEI STU (2007-2011)

[11] Doc. Ing. J. Novák, DrSc., member of editorial board of journal Metrológia a skúšobníctvo

[12] Doc. Ing. J. Novák, DrSc, member of editorial board of Journal of Electrical Engineering (2007-2011)

[13] Ing. Jozef Pitel, CSc., member of National Board for Cooperation with EURATOM (2011)

[14] Doc. RNDr. Silvester Takács, DrSc., Scientific council MFF UK (2007-2010)

[15] Doc. RNDr. Silvester Takács DrSc. member of editorial board of Acta Physica Comeniana (2007-2011)

[16] Doc. RNDr. Silvester Takács, DrSc., member of SKVH - Commission of Ministry of Education SR (2007-2011)

[17] RNDr. P. Ušák, PhD., member of Slovakian Committee for Cooperation of International Institute of Refrigeration (2007-2011)

[18] Doc. Ing. Jozef Novák, DrSc., SRDA – chair of Council of Programme SUSPP (2011)

[19] Ing. František Dubecký, CSc., SRDA – Council for Technical Science, member of workgroup (2011)

**iv. List of national awards and distinctions**

[1] Ing. E. Demenčík, PhD., winner of Competition of Young Scientists of SAS 2007 (SAS)

[2] Ing. Michal Vojenčiak, PhD., Student of Slovakia 2007 in category Electrical Engineering (Junior Chamber International)

[3] Ing. Milan Ťapajna, PhD. , winner of Competition of Young Scientists of SAS 2008 (SAS)

[4] Doc. RNDr. Silvester Takács, DrSc., Eminent Person of SAS 2008 (SAS)

[5] Mgr. Michaela Sojková, PhD., 3rd-4th place Competition of Youg Physicists 2008 (SPS)

[6] Mgr. Bohumír Zaťko, PhD., 3rd-4th place Competition of Youg Physicists 2008 (SPS)

[7] Mgr. Juraj Feilhauer, PhD., Student of Slovakia 2008/9 in category Electrical Engineering (Junior Chamber International)

[8] Ing. Karol Čičo, PhD., Price of President SR 2010

[9] Ing. Pavol Kováč, DrSc., Excellent Person of Science and Technology 2010 (ME SR)

[10] Ing. Ján Kuzmík, DrSc. and team (doc. Ing. Peter Kordoš, DrSc., RNDr. Dagmar Gregušová, CSc., Ing. Karol Čičo, PhD., Ing. Roman Stoklas, PhD., Price SAS for Scientific Activity 2011

[11] Ing. Boris Hudec, The Best PhD Student in Technical Sciences 2011 (INTENDA)

[12] Ing. Boris Hudec, Student of Slovakia 2011 in category Electrical Engineering (Junior Chamber International)

### v. Supplementary information and/or comments documenting international and national status of the Organisation

There were two events important at the European level between the international conferences organized by the Institute during the assessed period: EW-MOVPE 2007 a WoDiM 2010. The conferences are focused to the technology of III-V semiconductor thin film heterostructures and to application of dielectrics in microelectronics. Both events are regularly took place in EU countries and their organization underlines status of the Institute in the international context in the field of microelectronics. Response of the microelectronic community to the organisation of both events was very positive.

Conference ASDAM is organized every two years and Institute shares organization with the Faculty of Electrical Engineering and Informatics, STU. ASDAM is well established local conference with excellent list of invited speakers from all around the world.
Following researchers of the Institute took part in the assessment of international projects:

2007
Ing. Jozef Novák, DrSc., ESF
Ing. Peter Lobotka, CSc., ESF (2 committees)

2008
RNDr. Dušan Korytár, CSc. 7 FP EU
Ing. Jozef Novák, DrSc., ESF

2009
Ing. Jozef Novák, DrSc., ESF
RNDr. Dušan Korytár, CSc. 7 FP EU
Ing. Karol Fröhlich, DrSc. 7 FP EU

2010

| | |
|---|---|
| Ing. Jozef Novák, DrSc., | ESF |
| Ing. Jozef Novák, DrSc., | IRCSET (Ireland) |
| RNDr. Dušan Korytár, CSc. | 7 FP EU |
| Ing. Karol Fröhlich, DrSc. | ANR (France) |

2011

| | |
|---|---|
| RNDr. Dušan Korytár, CSc. | PICF (Programme Inter Carnot Fraunhofer, France – Germany) |
| Ing. Peter Lobotka, CSc., | COST |
| Ing. Jozef Novák, DrSc., | IRCSET (Ireland) |
| Ing. Jozef Novák, DrSc., | GA ČR (Czech Republic) |

Following researchers took part in the committees for defence of the DrSc. title:
Ing. Karol Fröhlich, DrSc.
Doc. Ing. Fedor Gömöry, DrSc.
Ing. Pavol Kováč, DrSc.
Ing. Ján Kuzmík, DrSc.
Doc. RNDr. Silvester Takács, DrSc.

## 4. Project structure, research grants and other funding resources

- **International projects and funding**

**i. List of major projects within the European Research Area – 6th and 7th Framework Programme of the EU, European Science Foundation, NATO, COST, INTAS, CERN, ESA etc. (here and in items below please specify: type of project, title, grant number, duration, total funding and funding for the Organisation, responsible person in the Organisation and his/her status in the project, e.g. coordinator, work package leader, investigator)**

[1] **Type of project:** 6th Framework Programme of the EU – STREP
**Project title:** Superconducting coated conductor cable – SUPER3C
**Project number:** SES6-CT-2004-502615
**Duration month/year-month/year:** 06/2004 – 11/2008
**Total funding**: 5156000
**Funding for Organisation within 2007-2011 (EUR):** 195371
**Responsible person and role:** doc. Ing. F. Gömöry DrSc., investigator

[2] **Type of project:** 6th Framework Programme of the EU – STREP
**Project title:** Nano- and micro-scale engineering of higher-performance $MgB_2$ composite superconductors for macro-scale applications - HIPERMAG
**Project number:** NMP3-CT-2004-505724
**Duration month/year-month/year:** 09/2004 – 08/2008
**Total funding**: 3318076
**Funding for Organisation within 2007-2011 (EUR):** 170799
**Responsible person and role:** Ing. P. Kováč DrSc., work package leader

[3] **Type of project:** 6th Framework Programme of the EU – CSA
**Project title:** AC losses measurements on high temperature superconductors
**Project number:** FU06-CT-2005-00047 No. 801465
**Duration month/year-month/year:** 12/2005 – 01/2008
**Total funding**: 192000
**Funding for Organisation within 2007-2011 (EUR):** 40000
**Responsible person and role:** doc. Ing. F. Gömöry DrSc., work package leader

[4] **Type of project:** 6th Framework Programme of the EU – STREP
**Project title:** InAlN/(In)GaN Heterostructure Technology for Ultra-high Power Microwave Transistor - ULTRAGAN
**Project number:** 006903
**Duration month/year-month/year:** 09/2005 – 08/2008
**Total funding**: 3012605
**Funding for Organisation within 2007-2011 (EUR):** 120741
**Responsible person and role:** Ing. K. Fröhlich, DrSc., investigator

[5] **Type of project:** 6th Framework Programme of the EU - Training Network
**Project title:** Nano-Engineering Superconductors for Power Applications - NESPA
**Project number:** MRTN-CT-2006-035619
**Duration month/year-month/year:** 10/2006 – 11/2010
**Total funding**: 4092585
**Funding for Organisation within 2007-2011 (EUR):** 442744
**Responsible person and role:** doc. Ing. F. Gömöry, DrSc., work package leader

[6] **Type of project:** 7th Framework Programme of the EU – NMP
**Project title:** Materials for Robust Gallium Nitride - MORGaN
**Project number:** CP-IP 214610-2
**Duration month/year-month/year:** 11/2008 – 10/2011
**Total funding**: 13862594
**Funding for Organisation within 2007-2011 (EUR):** 324677
**Responsible person and role:** Ing. K. Fröhlich, DrSc., investigator

[7] **Type of project:** 7th Framework Programme of the EU - Collaborative Project
**Project title:** Development and field testing of an efficient YBCO Coated Conductor based Fault Current Limiter for Operation in Electricity Networks - ECCOFLOW
**Project number:** Contract No. 241285
**Duration month/year-month/year:** 01/2010 – 12/2013
**Total funding**: 4615626
**Funding for Organisation within 2007-2011 (EUR):** 139839
**Responsible person and role:** doc. Ing. F. Gömöry, DrSc., investigator

[8] **Type of project:** 7th Framework Programme of the EU - Collaborative Project
**Project title:** GaN-based normally-off high power switching transistor for efficient power converters - HiPoSwitch
**Project number:** Contract No. 287602
**Duration month/year-month/year:** 09/2011 – 08/2014

**Total funding**: 3578938
**Funding for Organisation within 2007-2011 (EUR):** 164400
**Responsible person and role:** Ing. J. Kuzmík, DrSc., investigator

**ii. List of other international projects incl. total funding and funding for the Organisation**

[1] **Type of project:** COST
**Project title:** X-ray beam conditioning and imaging
**Project number:** MP0601
**Duration month/year-month/year:** 04/2007 – 10/2011
**Total funding**: 3578938
**Funding for Organisation within 2007-2011 (EUR):** 164400
**Responsible person and role:** RNDr. D. Korytár, CSc., investigator

[2] **Type of project:** COST
**Project title:** Composites of inorganic nanotubes and polymers - COINAPO
**Project number:** MP0902
**Duration month/year-month/year:** 06/2009 – 11/2013
**Total funding**: 3578938
**Funding for Organisation within 2007-2011 (EUR):** 164400
**Responsible person and role:** Ing. P. Lobotka, CSc., investigator

[3] **Type of project:** EURATOM
**Project title:** Development of new superconducting cables for DEMO
**Project number:** FU07-CT-2007-005
**Duration month/year-month/year:** 01/2009 – 12/2009
**Total funding**: 11832
**Funding for Organisation within 2007-2011 (EUR):** 6008
**Responsible person and role:** doc. Ing. F. Gömöry, DrSc., investigator

[4] ***Type of project:*** EURATOM
**Project title:** Development qualification of HTSC conductors for fusion magnets
**Project number:** FU07-CT-2007-0051
**Duration month/year-month/year:** 01/2010 – 12/2011
**Total funding**: 600071
**Funding for Organisation within 2007-2011 (EUR):** 120014
**Responsible person and role:** Ing. F. Dubecký, CSc., doc. Ing. F. Gömöry, DrSc., investigators

[5] **Type of project:** EUREKA
**Project title:** New power optics for infrared range based on gallium phosphide
**Project number:** EURE-0011-06
**Duration month/year-month/year:** 03/2007 – 04/2010
**Funding for Organisation within 2007-2011 (EUR):** 17153
**Responsible person and role:** doc. Ing. J. Novák, DrSc., investigator

[6] **Type of project:** European Office of Aerospace Research and Development – EOARD
**Project title:** Developing test apparatus and measurements of AC loss in HTS superconductors
**Project number:** FA8655-10-1-3079
**Duration month/year-month/year:** 09/2010 – 08/2012
**Funding for Organisation within 2007-2011 (EUR):** 40000
**Responsible person and role:** Ing. M. Polák, DrSc., investigator

**iii. List of other important projects and collaborations without direct funding**

[1] **Project title:** Thin films for novel oxide devices (THIOX)
**Responsible person in IEE SAS:** Ing. K. Fröhlich, DrSc.
**Duration:** 2003-2008
**Partner:** European Science Foundation - Network

[2] **Project title:** Basic and applied investigations of superconducting devices
**Responsible person in IEE SAS:** Ing. Š. Chromik, DrSc.
**Duration:** 2005-2007
**Partner:** Institute for Metal Physics, Donetsk Physical and Technical Institute, NASU, Ukraine

[3] **Project title:** Semiconductor detectors for diagnostics of hot plasma
**Responsible person in IEE SAS:** Ing. F. Dubecký, CSc.
**Duration:** 2005-2007
**Partner:** Institute of Laser Physic and Plasma Microfussion PAS, Poland

[4] **Project title:** Photoelectric phenomena on surface-barrier structure with quantum dots
**Responsible person in IEE SAS:** Ing. J. Osvald, DrSc.
**Duration:** 2005-2007
**Partner:** Institute of Semiconductors Physics, NASU, Ukraine

[5] **Project title:** Advanced nanostructures and materials for applications in informations and energy technologies. Structural and electrotechnical aspects
**Responsible person in IEE SAS:** doc. Ing. J. Novák, DrSc.
**Duration:** 2006-2007
**Partner:** ICMAB, Spain

[6] **Project title:** Thin oxide films for nanoelectric applications
**Responsible person in IEE SAS:** Ing. K. Fröhlich, DrSc.
**Duration:** 2006-2007
**Partner:** C.S.I.C., Spain

[7] **Project title:** InP detector structures
**Responsible person in IEE SAS:** Ing. F. Dubecký, CSc.

**Duration:** 2006 – 2008
**Partner:** Institute of Photonics and Electronics AS CR, Czech Republic

[8] **Project title:** Magnetic and electrical properties of thin film nanocomposites
**Responsible person in IEE SAS:** Ing. I. Vávra, CSc.
**Duration:** 2006-2008
**Partner:** Institute of Physics AS CR, Czech Republic

[9] **Project title:** Development of special technologies of Si monocrystal manifacturing
**Responsible person in IEE SAS:** RNDr. D. Korytár, CSc.
**Duration:** 2006-2008
**Partner:** Institute of Physics AS CR, Czech Republic

[10] **Project title:** Functional nanocomposite coatings with carbon nanotubes
**Responsible person in IEE SAS:** Ing. K. Sedláčková, PhD.
**Duration:** 2007-2009
**Partner:** Research Institute for Technical Physics and Materials Sciences, Hungary

[11] **Project title:** Semiconducting crystals for X-ray optics, Gamma-ray detectors and solar cells
**Responsible person in IEE SAS:** Ing. F. Dubecký, CSc.
**Duration:** 2007-2009
**Partner:** IMEM-CNR, Italy

[12] **Project title:** Superconducting and manganite thin films and structures for applications in cryoelectronics
**Responsible person in IEE SAS:** Ing. Š. Chromik, DrSc.
**Duration:** 2007-2009
**Partner:** Institute of Physics PAS, Poland

[13] **Project title:** Nanocomposite thin films
**Responsible person in IEE SAS:** Ing. I. Vávra, CSc.
**Duration:** 2007-2010
**Partner:** Research Institute for Technical Physics and Materials Sciences, Hungary

[14] **Project title:** Preparation and properties of superconducting, manganite and dielectric films for cryoelectronic structures
**Responsible person in IEE SAS:** Ing. Š. Chromik, DrSc.
**Duration:** 2010-2010
**Partner:** Institute of Physics PAS, Poland

- **National projects and funding**

**i. List of projects supported by the European Social Funds (ESF) and Structural Funds of EU and the role of the Organisation**

[1] **Project title:** Educational Centre for Information Technology and Power Engineering (VCITE)
**Project number:** No. 13120200043
**Duration month/year-month/year:** 01/2005 – 12/2009
**Funding for Organisation within 2007-2011 (EUR):** 113468 €
**Role of the Organisation:** Coordinator

[2] **Project title:** Creation of Virtual Network for R&D in the Field of Engineering Materials and Technologies (MatNet)
**Project number:** 13120200076
**Duration month/year-month/year:** 04/2006 – 05/2009
**Funding for Organisation within 2007-2011 (EUR):** 4189 €
**Role of the Organisation:** Investigator

[3] **Project title:** Center of Excellence for New Technologies in Electrical Engineering (CENTE I)
**Project number:** 26240120011
**Duration month/year-month/year:** 05/2009 – 05/2011
**Funding for Organisation within 2007-2011 (EUR):** 1285205
**Role of the Organisation:** Coordinator

[4] **Project title:** Centre of knowledge commercialization and intellectual property rights management of the Slovak Academy of Sciences
**Project number:** 26240220006
**Duration month/year-month/year:** 10/2009 – 03/2012
**Funding for Organisation within 2007-2011 (EUR):** 8035
**Role of the Organisation:** Investigator

[5] **Project title:** Center of Excellence for New Technologies in Electrical Engineering II. (CENTE II)
**Project number:** 26240120019
**Duration month/year-month/year:** 03/2010 – 02/2013
**Funding for Organisation within 2007-2011 (EUR):** 1788381
**Role of the Organisation:** Coordinator

[6] **Project title:** Development of HD video universal platform for application in broadcasting, education and research (HD Video)
**Project number:** 26240220041
**Duration month/year-month/year:** 02/2010 – 01/2013
**Funding for Organisation within 2007-2011 (EUR):** 348039
**Role of the Organisation:** Investigator

[7] **Project title:** Effective control of production and consumption of energy from renewable sources
**Project number:** 2624220028
**Duration month/year-month/year:** 04/2010 – 03/2013
**Funding for Organisation within 2007-2011 (EUR):** 169879
**Role of the Organisation:** Investigator

[8] **Project title:** Center of competence for new materials, advanced technologies and power engineering
**Project number:** 26240220073
**Duration month/year-month/year:** 08/2011 – 07/2014
**Funding for Organisation within 2007-2011 (EUR):** 14779
**Role of the Organisation:** Coordinator

**ii. List of projects supported by APVV and the role of the Organisation**

[1] **Project title:** Thin oxide films for advanced MOS structures
**Project number:** 51-017004
**Duration month/year-month/year:** 02/2005 – 12/2007
**Funding for Organisation within 2007-2011 (EUR):** 41492
**Role of the Organisation:** Coordinator

[2] **Project title:** Superconductors for future technologies
**Project number:** 51-016604
**Duration month/year-month/year:** 01/2005 – 12/2007
**Funding for Organisation within 2007-2011 (EUR):** 5975
**Role of the Organisation:** Investigator

[3] **Project title:** Monolithically integrated microsystem for gas detection based on GaAs micromechanical structures
**Project number:** 20-021004
**Duration month/year-month/year:** 01/2005 – 12/2007
**Funding for Organisation within 2007-2011 (EUR):** 9958
**Role of the Organisation:** Investigator

[4] **Project title:** A new generation digital radiology system kit
**Project number:** 99-PO6305
**Duration month/year-month/year:** 01/2005 – 06/2007
**Funding for Organisation within 2007-2011 (EUR):** 59052
**Role of the Organisation:** Investigator

[5] **Project title:** Preparation of high quality GaMnN thin layers for spintronics
**Project number:** 20-026104
**Duration month/year-month/year:** 01/2005 – 12/2007
**Funding for Organisation within 2007-2011 (EUR):** 5460
**Role of the Organisation:** Investigator

[6] **Project title:** Superconducting wires in the conditions of power electric devices
**Project number:** 51-045605
**Duration month/year-month/year:** 05/2006 – 04/2009
**Funding for Organisation within 2007-2011 (EUR):** 161124
**Role of the Organisation:** Coordinator

[7] **Project title:** Coherence, decoherence and disorder in metallic and superconducting systems
**Project number:** 51-003505
**Duration month/year-month/year:** 05/2006 – 05/2009
**Funding for Organisation within 2007-2011 (EUR):** 41790
**Role of the Organisation:** Investigator

[8] **Project title:** Monolitically integrated circuits based on GaAs (GaN) with passive superconducting filters for millimeter wave band
**Project number:** 51-040605
**Duration month/year-month/year:** 05/2006 – 04/2009
**Funding for Organisation within 2007-2011 (EUR):** 119133
**Role of the Organisation:** Coordinator

[9] **Project title:** Pinning in the new types of superconducting wires
**Project number:** LPP-0815-06
**Duration month/year-month/year:** 11/2006 – 12/2011
**Funding for Organisation within 2007-2011 (EUR):** 19592
**Role of the Organisation:** Coordinator

[10] **Project title:** The study of electric current distribution processes in superconducting conductors at DC and AC applications
**Project number:** 51-002305
**Duration month/year-month/year:** 05/2006 – 04/2008
**Funding for Organisation within 2007-2011 (EUR):** 119133
**Role of the Organisation:** Coordinator

[11] **Project title:** The dynamics of current distribution in 2nd generation superconductors for AC applications
**Project number:** LPP-0245-06
**Duration month/year-month/year:** 11/2006 – 06/2007
**Funding for Organisation within 2007-2011 (EUR):** 13344
**Role of the Organisation:** Coordinator

[12] **Project title:** Preparation of "active" tips for probe microscopy by MOCVD
**Project number:** 51-045705
**Duration month/year-month/year:** 03/2006 – 04/2010
**Funding for Organisation within 2007-2011 (EUR):** 192989
**Role of the Organisation:** Coordinator

[13] **Project title:** Monolithically integrated HEMT-SAW chemical sensors based AlGaN piezoelectric material system
**Project number:** SK-FR-01906
**Duration month/year-month/year:** 01/2006 – 12/2007
**Funding for Organisation within 2007-2011 (EUR):** 2656
**Role of the Organisation:** Coordinator

[14] **Project title:** Electro-thermal converter monolithically integrated with HEMT-SAW chemical sensors
**Project number:** SK-95/CZ-80
**Duration month/year-month/year:** 01/2006 – 12/2007
**Funding for Organisation within 2007-2011 (EUR):** 1062
**Role of the Organisation:** Coordinator

[15] **Project title:** Thin oxide films for GaN heterostructures
**Project number:** RPEU-0017-06
**Duration month/year-month/year:** 03/2007 – 11/2008
**Funding for Organisation within 2007-2011 (EUR):** 49790
**Role of the Organisation:** Coordinator

[16] **Project title:** Selected topics from X-ray technologies
**Project number:** 51-0459-06
**Duration month/year-month/year:** 02/2007 – 12/2009
**Funding for Organisation within 2007-2011 (EUR):** 136526
**Role of the Organisation:** Coordinator

[17] **Project title:** Electromagnetic properties of composite tapes
**Project number:** SK-CN-0015-07
**Duration month/year-month/year:** 03/2008 – 12/2009
**Funding for Organisation within 2007-2011 (EUR):** 3983
**Role of the Organisation:** Coordinator

[18] **Project title:** Transport and microwave characteristics of magnesium diboride, a novel superconducting material for practical applications
**Project number:** SK-UA-000407
**Duration month/year-month/year:** 02/2008 – 12/2009
**Funding for Organisation within 2007-2011 (EUR):** 5642
**Role of the Organisation:** Coordinator

[19] **Project title:** Advanced filamentary composite $MgB_2$ superconductors
**Project number:** 0398-07
**Duration month/year-month/year:** 03/2008 – 12/2010
**Funding for Organisation within 2007-2011 (EUR):** 139945
**Role of the Organisation:** Coordinator

[20] **Project title:** Carbon nanocomposites for chemical sensing
**Project number:** 0478-07
**Duration month/year-month/year:** 06/2008 – 05/2011
**Funding for Organisation within 2007-2011 (EUR):** 161720
**Role of the Organisation:** Coordinator

[21] **Project title:** Advanced MEMS chemical sensors for extreme conditions
**Project number:** 0655-07
**Duration month/year-month/year:** 06/2008 – 04/2011

**Funding for Organisation within 2007-2011 (EUR):** 197868
**Role of the Organisation:** Coordinator

[22] **Project title:** High temperature superconducting films and structures for microwave
**Project number:** LPP-0078-07
**Duration month/year-month/year:** 06/2008 – 05/2011
**Funding for Organisation within 2007-2011 (EUR):** 49790
**Role of the Organisation:** Coordinator

[23] **Project title:** Structure metal-insulator-metal for nanoscale DRAM memories
**Project number:** 0133-07
**Duration month/year-month/year:** 09/2008 – 06/2011
**Funding for Organisation within 2007-2011 (EUR):** 159430
**Role of the Organisation:** Coordinator

[24] **Project title:** Technology and characterization of modern semiconductor thin films for microelectronics and optoelectronics
**Project number:** 0713-07
**Duration month/year-month/year:** 09/2008 – 04/2011
**Funding for Organisation within 2007-2011 (EUR):** 150799
**Role of the Organisation:** Coordinator

[25] **Project title:** Centre of excellence NAno-/Mikro-elektronics, optoelektronics and senzoric technologies
**Project number:** VVCE-0049-07
**Duration month/year-month/year:** 07/2008 – 06/2011
**Funding for Organisation within 2007-2011 (EUR):** 179245
**Role of the Organisation:** Investigator

[26] **Project title:** Research work on formation and properties of pyrolytic boron nitride
**Project number:** VMSP-P-0051-07
**Duration month/year-month/year:** 01/2008 – 12/2009
**Funding for Organisation within 2007-2011 (EUR):** 18926
**Role of the Organisation:** Investigator

[27] **Project title:** Centre of Cryophysics and Cryonanoelectronics
**Project number:** VVCE-0058-07
**Duration month/year-month/year:** 07/2008 – 06/2011
**Funding for Organisation within 2007-2011 (EUR):** 149338
**Role of the Organisation:** Investigator

[28] **Project title:** Epi-ready substrates VGF GaP (S)
**Project number:** 0731-07
**Duration month/year-month/year:** 06/2008 – 12/2010
**Funding for Organisation within 2007-2011 (EUR):** 22538
**Role of the Organisation:** Investigator

[29] **Project title:** MOS HFET transistors based on III-V semiconductors for high-temperature applications
**Project number:** LPP0162-09
**Duration month/year-month/year:** 09/2009 – 08/2011
**Funding for Organisation within 2007-2011 (EUR):** 45648
**Role of the Organisation:** Coordinator

[30] **Project title:** AlN synthesis based on PBN technology
**Project number:** VMSP-P-0110-09
**Duration month/year-month/year:** 09/2009 – 09/2011
**Funding for Organisation within 2007-2011 (EUR):** 19406
**Role of the Organisation:** Investigator

[31] **Project title:** Technologies of formation of modern semiconductor SiC, AlNfilms for microelectronics and optoelectronics applications
**Project number:** SK-UA-0011-09
**Duration month/year-month/year:** 01/2010 – 12/2011
**Funding for Organisation within 2007-2011 (EUR):** 5460
**Role of the Organisation:** Coordinator

[32] **Project title:** Modern high resolution X-ray imaging techniques
**Project number:** SK-PL-0059-09
**Duration month/year-month/year:** 01/2010 – 12/2011
**Funding for Organisation within 2007-2011 (EUR):** 2996
**Role of the Organisation:** Coordinator

[33] **Project title:** Advanced GaN mechanical sensors for extreme conditions
**Project number:** SK-FR-0041-09
**Duration month/year-month/year:** 01/2010 – 12/2011
**Funding for Organisation within 2007-2011 (EUR):** 5292
**Role of the Organisation:** Coordinator

[34] **Project title:** Metal-oxide-metal structures for resistive switching based memory cells
**Project number:** 0509-10
**Duration month/year-month/year:** 05/2011 – 04/2014
**Funding for Organisation within 2007-2011 (EUR):** 55668
**Role of the Organisation:** Coordinator

[35] **Project title:** Fine-filamentary superconducting $MgB_2$ wires for steady and alternating current windings
**Project number:** 0495-10
**Duration month/year-month/year:** 05/2011 – 09/2014
**Funding for Organisation within 2007-2011 (EUR):** 42611
**Role of the Organisation:** Coordinator

[36] **Project title:** Towards next generation of III-N high-electron-mobility transistors
**Project number:** 0104-10
**Duration month/year-month/year:** 05/2011 – 04/2014
**Funding for Organisation within 2007-2011 (EUR):** 33588
**Role of the Organisation:** Coordinator

[37] **Project title:** Advanced piezoelectric MEMS pressure sensors
**Project number:** 0450-10
**Duration month/year-month/year:** 05/2011 – 10/2014
**Funding for Organisation within 2007-2011 (EUR):** 63320
**Role of the Organisation:** Coordinator

[38] **Project title:** Multifunctional detector arrays based on micromechanical structures
**Project number:** 0199-10
**Duration month/year-month/year:** 05/2010 – 10/2014
**Funding for Organisation within 2007-2011 (EUR):** 11366
**Role of the Organisation:** Investigator

[39] **Project title:** Micro- and nano-process technology foradvanced MEMS sensors
**Project number:** SK-AT-0019-10
**Duration month/year-month/year:** 01/2011 – 12/2012
**Funding for Organisation within 2007-2011 (EUR):** 1997
**Role of the Organisation:** Coordinator

[40] **Project title:** Growth of nanowires for photovoltaic applications
**Project number:** 0301-10
**Duration month/year-month/year:** 05/2011 – 10/2014
**Funding for Organisation within 2007-2011 (EUR):** 41582
**Role of the Organisation:** Coordinator

**iii. Number of 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 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| number | 12 | 11 | 12 | 14 | 16 |
| funding in the year (EUR) | 84047 | 87034 | 89887 | 133673 | 127062 |

- **Summary of funding from external resources (based on annual financial report of the Organisation)**

| External resources | 2007 | 2008 | 2009 | 2010 | 2011 | total | average |
|---|---|---|---|---|---|---|---|
| external resources (milions of EUR) | 0,948 | 1,204 | 1,999 | 1,845 | 2,907 | 8,903 | 1,781 |
| external resources transfered to coooperating research organisations (milions of EUR) | 0,042 | 0,705 | 0,089 | 0,066 | 1,006 | 1,908 | 0,382 |
| ratio between external resources and total salary budget | 1,116 | 1,334 | 2,108 | 1,906 | 3,141 | 9,606 | 1,921 |
| overall expenditures from external as well as institutional resources (milions of EUR) | 2,908 | 2,651 | 3,452 | 3,244 | 4,403 | 16,658 | 3,332 |

**iv. Supplementary information and/or comments on research projects and funding resources**

**National projects started before 2007**

[1] **Type of project:** Centre of Excellence SAS
**Project title:** Centre of electronic and electrotechnique advanced devices - CENG
**Project number:** 01/2005
**Duration month/year-month/year:** 01/2005 – 12/2008
**Funding for Organisation within 2007-2011 (EUR):** 65724
**Role of the Organisation:** Coordinator

## 5. Organisation of PhD studies, other pedagogical activities

**i. List of accredited programmes of doctoral studies (as stipulated in the previously effective legislation as well as in the recently amended Act on the Universities)**

**List of programmes accredited until 2010**

[1] 11-22-9 “Physics of condensed matter and acoustics”
[2] 26-02-9 “Theoretical electrotechnics”
[3] 26-13-9 “Electronics”
[4] 26-35-9 “Electrotechnology and materials”

**List of programmes accredited since 2004**

[1] 4.1.3 "Physics of condensed matter and acoustics"
[2] 5.2.13 "Microelectronics"
[3] 5.2.48 "Physical Engineering"

**ii. Summary table on doctoral studies (number of internal/external PhD students; number of students who completed their study by a successful thesis defence; number of PhD students who quitted the programme)**

| PhD study | 31.12.2007 | | | 31.12.2008 | | | 31.12.2009 | | | 31.12.2010 | | | 31.12.2011 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| number of potential PhD supervisors | | | | | | | | | | | | | | | |
| PhD students | number | defended thesis | students quitted | number | defended thesis | students quitted | number | defended thesis | students quitted | number | defended thesis | students quitted | number | defended thesis | students quitted |
| internal | 9 | 3 | 0 | 11 | 3 | | 12 | 4 | 1 | 11 | 6 | 0 | 16 | 2 | |
| external | 1 | | | 1 | | | 1 | | | 1 | | | | | 1 |
| supervised at external institution by the research employees of the assessed organisation | | | | | | | | | | | | | | | |

**iii. Postdoctoral positions supported by**

***a) external funding (specify the source)***

*APVV/LPP* Mgr. Eugen Seiler, PhD.
Ing. Eduard Demenčík, PhD.
Mgr. Michaela Valeriánová-Sojková, PhD.
Ing. Roman Stoklas, PhD.

***b) internal funding - the Slovak Academy of Sciences Supporting Fund of Stefan Schwarz***

[1] Mgr. Eugen Seiler, PhD.
[2] Ing. Eduard Demenčík, PhD.
[3] Ing. Ján Šoltýs, PhD.
[4] Ing. Milan Ťapajna, PhD.
[5] Mgr. Michaela Valeriánová-Sojková, PhD.
[6] Mgr. Tomáš Holúbek, PhD.
[7] Ing. Roman Stoklas, PhD.
[8] Ing. Karol Čičo, PhD.

**iv. Summary table on pedagogical activities in undergraduate programmes for each year**

| Teaching | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| lectures (hours/year) | 251 | 111 | 303 | 182 | 168 |
| practicum courses (hours/year) | 261 | 263 | 24 | 80 | 62 |
| supervised diploma works (in total) | 9 | 12 | 12 | 13 | 16 |
| members in PhD committees (in total) | 9 | 4 | 8 | 9 | 8 |
| members in DrSc. committees (in total) | 6 | 8 | 4 | 7 | 2 |
| members in university/faculty councils (in total) | 2 | 1 | 1 | 1 | 1 |
| members in habilitation/inauguration committees (in total) | 3 | 2 | 0 | 4 | 0 |

**v. List of published university textbooks**

[1] CAMBEL, Vladimír - ČENČARIKOVÁ, Hana - FARKAŠOVSKÝ, Pavol - FLACHBART, Karol - GRAJCAR, Miroslav - MAHEĽ, Michal - MOŠKOVÁ, Antónia - MOŠKO, Martin - REIFFERS, Marián - SAMUELY, Peter - SAMUELY, Tomáš - SKYBA, Peter - SZABÓ, Pavol - ŠOLTÝS, Ján. Kryofyzika a nanoelektromika. V. Cambel [et al.]. Košice : Ústav experimentálnej fyziky, 2011. 338 s. ISBN 978-80-968060-9-6.

**vi. Number of published academic course books**

**vii. List of joint research laboratories/facilities with the universities**

**viii. Supplementary information and/or comments on doctoral studies and pedagogical activities**

Average duration of the PhD study at the Institute is about 4 years. We suppose that in technical science PhD student needs about 4 years to submit PhD thesis with a good quality. It should be noted that all PhD students within the assessed period finished their PhD study successfully by defence after about 4 years. However, only 3 years of the PhD study are covered by PhD scholarship. The fourth year of the study is financed from our own resources, partially from salary budget and research projects.

2 PhD students from abroad (J. Viljamaa from Finland and M. Solovyov from Ukraine) were supported by the project 7 FP NESPA during 3 years.

2 PhD students O. Cicek and S. Safran from Turkey visited the Institute for 1 year with the support of the 7 FP NESPA project.

47 diploma works lead by researchers of the Institute were performed within the assessed period.

## 6. Applied research

### i. List of the most important results of applied research projects and their socio-economic impact

**Title:** High-Tc superconductor based conductor with low AC losses
**Partner:** Wright Patterson Air Force, Dayton, Ohio, USA (European Office of Aerospace Research and Development)
**Duration:** 2010-2012
**Revenues:** 40000 Eur

**Title:** Fabrication of GaAs radiation detector for X-ray application
**Partner:** RIGAKU Corporation, Tokyo, Japan
**Duration:** 2010-2011
**Revenues:** 13666 Eur

### ii. List of the most important studies commissioned for the decision-making authorities, the government and NGOs, international and foreign organisations

### iii. List of patents issued abroad, incl. revenues

[1] BARNES, Paul N., POLÁK, Milan, and VARANASI, Chakrapani: AC-tolerant HTS coated conductor with transposed filaments. US Patent No. 7,756,557.
[2] FERRARI, C. and KORYTÁR, D.: Monocromatore monolitico per difrattometria X ad alta risoluzione e ad alta efficienza. Brevetto No. 0000265480, Roma 2010.

### iv. List of the patents issued in Slovakia, incl. revenues

[1] CHROMIK, Štefan, a VINCENC OBOŇA, Jozef: Spôsob tvarovania tenkých vrstiev v kryotechnike s použitím fullerénu $C_{60}$. ÚPV SR PV 286586.
[2] CHROMIK, Štefan, KOSTIČ, Ivan a VINCENC OBOŇA, Jozef: Spôsob tvarovania submikrometrových štruktúr v kryotechnike s použitím fullerénu $C_{60}$. ÚPV SR PV 286519.
[3] UŠÁK, Pavol, MOZOLA, Pavol a POLÁK, Milan: Spôsob mapovania vybranej zložky vlastného magnetického poľa kábla. ÚPV SR PV 287557.

### v. List of licences sold abroad, incl. revenues

### vi. List of licences sold in Slovakia, incl. revenues

### vii. List of contracts with industrial partners, incl. revenues

[1] **Title:** Calculation of losses TriAlpha magnetic system
**Partner:** Oxford Instruments Ltd
**Duration:** 2007
**Revenues:** 5197 €

[2] **Title:** Measurements of two-monofilar coils
**Partner:** NEXANS Supercond., Germany
**Duration:** 2007
**Revenues:** 4000 €

[3] **Title:** SEM examinations
**Partner:** Inst. for Single Crystals, Kharkov
**Duration:** 2007
**Revenues:** 4200 €

[4] **Title:** Dioda TFD400
**Partner:** NATE a.s., Choteboř
**Duration:** 2007
**Revenues:** 3360 €

[5] **Title:** Dioda TFD400
**Partner:** Rheinische-Westfalische Hochschule Aachen
**Duration:** 2007
**Revenues:** 3125 €

[6] **Title:** Calibrated and non-calibrated Hall Probes
**Partner:** AREPOC, s r.o.
**Duration:** 2007 - 2010
**Revenues:** 24252 €

[7] **Title:** Development of voltage standard of new generation?
**Partner:** Slovenský metrologický ústav
**Duration:** 2008 - 2010
**Revenues:** 11119 €

[8] **Title:** TEM analysis
**Partner:** ON Semicond. Slovakia, Piešťany
**Duration:** 2009
**Revenues:** 950 €

[9] **Title:** Hall probe
**Partner:** Bront, a.s.
**Duration:** 2009
**Revenues:** 1240 €

[10] **Title:** Fabrication and processing MSM devices of implanted GaAs and InP
**Partner:** Univ. of Athens
**Duration:** 2009
**Revenues:** 650 €

[11] **Title:** Preparation of testing structures by electron litography
**Partner:** TESCAN, s.r.o. Brno
**Duration:** 2009
**Revenues:** 1892 €

[12] **Title:** Digital radiology system kit
**Partner:** Magic Trading Corp, s r.o.
**Duration:** 2009
**Revenues:** 2411 €

[13] **Title:** Fabrication of GaAs radiation detector for X-ray application
**Partner:** RIGAKU Corporation, Tokyo, Japan
**Duration:** 2010 - 2011
**Revenues:** 13666 €

[14] **Title:** Analysis of GaN-based structures with various dielectric film
**Partner:** VisIC Technologies Ltd.
**Duration:** 2011
**Revenues:** 5000 €

[15] **Title:** Magnetization and AC loss in superconducting cables
**Partner:** KIT Karlsruhe, Germany
**Duration:** 2011
**Revenues:** 3500 €

[16] **Title:** Measurements of magnetization of metal materials
**Partner:** Univ. Limerick, Ireland
**Duration:** 2011
**Revenues:** 3500 €

[17] **Title:** Magnetization and AC loss in superconducting wires and cables
**Partner:** CERN
**Duration:** 09/2011 – 08/2013
**Revenues:** € (project not yet finished)

### viii. List of research projects with industrial partners, incl. revenues

[1] **Title:** Superconducting coated conductor cable – SUPER3C ($6^{th}$ FP EU)
**Duration:** 06/2004 – 11/2008
**Partners:** Nexans, Air Liquide S.A., France, ZFW, Sweden, EON Energie Germany, LABEIN Spain

[2] **Title:** Nano- and micro-scale engineering of higher-performance $MgB_2$ composite superconductors for macro-scale applications - HIPERMAG ($6^{th}$ FP EU)
**Duration:** 09/2004 – 08/2008
**Partners:** Forschungszentrum Karlsruhe GmbH, Germany

[3] **Title:** InAlN/(In)GaN Heterostructure Technology for Ultra-high Power Microwave Transistor - ULTRAGAN ($6^{th}$ FP EU)
**Duration:** 09/2005 – 08/2008
**Partners:** Aixtron AG, MicroGaN GmbH, Germany

[4] **Title:** Materials for Robust Gallium Nitride - MORGaN ($7^{th}$ FP EU)
**Duration:** 11/2008 – 10/2011
**Partners:** AIXTRON SE, Germany, MicroGaN GmbH, Germany, Fcubic AB, Sweden, Impact Coatings AB, Sweden, Element Six Ltd., Ireland, Gwent Electronic Materials Ltd, UK, SIFAM Fibre Optics, Torquay, UK, Vivid Components Ltd., UK, Alcatel-Thales III-V Lab, France

[5] **Title:** Development and field testing of an efficient YBCO Coated Conductor based Fault Current Limiter for Operation in Electricity Networks - ECCOFLOW ($7^{th}$ FP EU)
**Duration:** 01/2010 – 12/2013
**Partners:** Nexans France S.A.S (NXF), France, Air Liquide S.A., France, RWE Rhein-Ruhr Netzservice GmbH, Germany, Vychodoslovenska energetika A.S (VSE), SK, Endesa Distributión Eléctrica S.L., Spain, Fundacion Labein (Tecnalia-LAB), Spain, Vattenfall Research and Development AB, Sweden, A2A RETI Elettriche S.p.A., Italy, CESI RICERCA S.p.A., Italy

[6] **Title:** GaN-based normally-off high power switching transistor for efficient power converters - HiPoSwitch ($7^{th}$ FP EU)
**Duration:** 09/2011 – 08/2014
**Partners:** EpiGaN, Leuven, Belgium, AIXTRON SE, Germany

[7] **Title:** New power optics for infrared range based on gallium phosphide (EUREKA)
**Duration:** 03/2007 – 04/2010
**Partner:** Phostec, s.r.o., Žarnovica

[8] **Title:** European Office of Aerospace Research and Development (EOARD)
**Duration:** 09/2010 – 08/2012
**Partner:** EOARD, London, UK

[9] **Title:** Epi-ready substrates VGF GaP (S) (APVV)
**Duration:** 06/2008 – 12/2010
**Partner:** Phostec, s.r.o., Žarnovica

[10] **Title:** AlN synthesis based on PBN technology (APVV)
**Duration:** 09/2009 – 09/2011
**Partner:** Phostec, s.r.o., Žarnovica

[11] **Title:** Development of HD video universal platform for application in broadcasting, education and research (Structural Funds of EU)
**Duration:** 02/2010 – 01/2013
**Partner:** Monogram Technologies, spol. s r.o., Bratislava

[12] **Title:** Center of competence for new materials, advanced technologies and power engineering (Structural Funds of EU)
**Duration:** 08/2011 – 07/2014
**Partner:** Monogram Technologies, spol. s r.o., Slovenské elektrárne, a.s., Geothermal Anywhwere, s.r.o., Západoslovenská energetika, a.s., ZSE Distribúcia, a.s., E.ON Slovensko, a.s., Siemens, s.r.o., MicroStep HDO, s.r.o., SCHRACK TECHNIK, s.r.o.

**ix.**

| Outreach activities | 2007 | 2008 | 2009 | 2010 | 2011 | total |
|---|---|---|---|---|---|---|
| **studies for the decision sphere, government and NGOs, international and foreign organisations** | | | | | | 0 |

## x. Supplementary information and/or comments on applied research

Focus of the Institute in the field of applied research was oriented to research projects, in particular to the projects of the EU Framework Programme. In majority cases there are industrial partners in the EU FP projects. Within the list of research projects with industrial partners we present EU FP projects in which activities were dirtected toward applied research output.

The project funded by the European Office of Aerospace Research and Development (EOARD) was running during 2010-2011.

Besides FP projects 3 applied projects supported by the APVV were running during the assessed period.

The total revenues from the contracts with industrial partners (not research projects) reached 141 657 € during the whole assessed period. According to the internal rules, part of this revenues was paid to the researchers, participating on the contract. The rest of income was re-injected in the activities of the Institute itself.

## 7. Popularisation of Science

### i. List of the most important popularisation activities

[1] Day of open doors IEE, 216 participants, Nov. 2007
[2] Day of open doors IEE, 190 participants, Nov. 2008
[3] Day of open doors IEE, 180 participants, Nov. 2009
[4] Day of open doors IEE, 153 participants, Nov. 2010
[5] Day of open doors IEE, 182 participants, Nov. 2011
[6] Kováč, P.: Zlomený odpor. Paper in: Revue priemyslu č. 2 (2007).
[7] Cambel, V. a Gregušová, D.: Svetový unikát zo Slovenska. Paper in: Revue priemyslu č. 4 (2007).
[8] Fröhlich, K.: Supravodivé magnety. Interview for Rádiožurnál Slov. rozhlasu. 4.11. 2007
[9] Fröhlich, K.: Vedci na Slovensku vyvíjajú supravodiče. Paper in: Pravda 4.11. 2007
[10] Fröhlich, K.: Slovenskí vedci riešia nedostatok elektriny. www.aktualne.sk
[11] Demenčík, E.: Zamerané na vysokoteplotné supravodiče. Paper in: Quark č. 12 (2007).
[12] Day of open doors IEE for teachers of physics, 12 participants, 23.10.2007.
[13] Deň otvorených dverí na Elektrotechnickom ústave SAV. Interview for Slovak Radio 13. 11. 2007
[14] Researcher`s Night 2008. Presentation.
[15] Šmatko, V. a Kováčová, E.: Moderné technológie v praxi. Lecture in Slovak National Museum.
[16] Dobročka, E.: Využitie RTG difrakcie v materiálovom výskume. Seminár Progresívne metódy štúdia mikroštruktúry materiálov. Bratislava: ÚMMS SAV 2008. Lecture.
[17] Fröhlich, K.: Granty nie sú všeliek. Paper in: Revue priemyslu, október 2008.
[18] Fröhlich, K.: V ústave SAV otvorili čisté priestory pre vývoj mikroelektronických súčiastok. Interview for www.Počítače.sme.sk, 13.3. 2008.
[19] Chromik, Š.: Supravodivé tenké vrstvy pre kryoelektroniku. Letná škola v rámci projektu Centrum rozvoja vzdelávania v oblasti multidisciplinárneho výskumu a vývoja progresívnych materiálov a technológií. Košice: ÚEF SAV 2008. Lecture for Summer School.
[20] Kováčová, E. a Frolek, L.: Zázraky a kúzla vedy a techniky. Presentation www.aktuálne.sk. 3. 12. 2008.
[21] Kováč, P.: 20-ročná história vysokoteplotných supravodičov. Bratislava: Klub fyzikov na FEI STU 2008. Lecture.
[22] Kováč, P.: Supravodiče pre elektromagnety na vysoké polia. Bratislava: SjF STU 2008. Lecture.
[23] Kováč, P. : Elektromechanické vlastnosti kompozitných supravodičov. Bratislava: SjF STU 2008. Lecture.

[24] Kováč, P. Vláknité supravodiče použiteľné pre vinutia magnetických systémov. Letná škola v rámci projektu Centrum rozvoja vzdelávania v oblasti multidisciplinárneho výskumu a vývoja progresívnych materiálov a technológií. Košice: ÚEF SAV 2008. Lecture for Summer School.

[25] Kováč, P.: Kompozitné supravodiče pre vinutia generujúce vysoké magnetické polia. Seminár Nové materiály s výnimočnými fyzikálnymi vlastnosťami pre elektrotechniku. Bratislava: ÚMMS SAV 2007. Lecture.

[26] Štrbik, V.: Vypínajte spotrebiče – ušetríte. Interview for Radio Expres 11. 11. 2008.

[27] Vávra, I.: Nanoštruktúrne materiály v elektrotechnike. Seminár Nanoštruktúrne kovové materiály. Bratislava: ÚMMS SAV 2008. Lecture.

[28] Chapters in book: Rozprávanie o materiáloch a technológiách. - Bratislava: ÚMMS SAV, 2008

1. CAMBEL, Vladimír - ŠOLTÝS, Ján. Skenovacia sondová mikroskopia vo výskume povrchov materiálov. S. 81-92.
2. FRÖHLICH, Karol. Ako polovodiče spôsobili informačnú revolúciu. S. 17-24.
3. KOVÁČ, Pavol. Supravodivé vláknité vodiče vytvárajúce silné magnetické polia. S. 107-116.
4. SOJKOVÁ, Michaela. Diamanty. S. 99-106.

[29] Cambel, V.: Vedecká cukráreň June 2009: Nanotechnológie - prázdne heslo alebo svetlá budúcnosť? Lecture with DVD.

[30] Gömöry, F.: Projekt na výskum supravodičov. Interview for Radio Slovensko 26. 5. 2009.

[31] Gömöry, F., Vojenčiak, M.: Naša veda dosiahla úspech. Interview for STV1, Slovensko dnes. 26.5.2009.

[32] Martaus, J.: Kreslenie atómovým silovým mikroskopom. Paper in: QUARK (2009), č. 8, s. 8-9 (2009).

[33] Noc výskumníka 2009 Bratislava 25.9.2009. Presentation..

[34] Cambel, V.: Polovodiče a nanotechnológie. Lecture for students SŠE. 2010.

[35] Fröhlich, K.: Materiály pre počítače novej generácie. Lecture for students SŠE. 2010.

[36] Fröhlich, K.: Materiály pre počítače novej generácie. Lecture for students FCHTP STU. 2010.

[37] Fröhlich, K.: Slovenský tiger je predposledný. Paper in: SME 21.9.2010.

[38] Fröhlich, K.: Zaujíma vás vedecká práca? Paper in: OKO (http://oko.fei.sk/). 2010

[39] Lobotka, P.: Fyzik, ktorý sa rád hrá. Paper in: Správy SAV 2010.

[40] 5th Czech Photovoltaic Conf. and Exhibition. Brno 10.11.2010. Presentation.

[41] Vávra, I.: Fyzikálne a chemické základy nanotechnológie. Lecture for Inst. Experiment. Oncology SAS 2010.

[42] Vávra, I., V. Šmatko, Z. Križanová, A. Rosová, P. Lobotka, T. Vystavěl: Dual beam microcsope applications in microelectronics. Brno, Lecture for TESCAN 2010.

[43] Noc výskumníka 2010 Bratislava 24. 10. 2010. Presentation.

[44] Fröhlich, K.: Chcete pokračovať v štúdiu ako doktorand? Paper in: Časopis OKO (http://oko.fei.sk/) 2011.

[45] Fröhlich, K.: Spektrum vedy. STV2 2.2.2011. Presentation in TV.

[46] Fröhlich, K.: Výsledky výskumu v oblasti elektrotechniky na SAV: uplatnenie doma a vo svete. Konferencia Zväzu elektrotechnického priemyslu SR 2.6.2011.

Lecture.
[47] Gömöry, F.: Supravodivé magnety pre fúziu. FUSION EXPO: Fúzia – energia budúcnosti (Avion) 2-3. 2. 2011. Lecture.
[48] Noc výskumníka 2011 Bratislava 23.9.2011. Presentation.
[49] Šmatko, V.: Objavovňa a zimná záhrada. Presentation in Slovak National Museum 23.9.2011.
[50] Takács, S.: Akadémia na rozhraní. Paper in: Správy SAV 2011.
[51] Vávra, I.: Nanotechnológie vo vede, technike a prírode. Lecture for IM SAS 2010, 2011
[52] Vávra, I., Šmatko, V., Križanová, Z. a Vystavěl, T.: Rastrovací mikroskop s dvoma zväzkami nabitých častíc – nový nástroj pre defektoskopiu. Paper in: Zvárač, 2011, roč. VIII, č. 1, s. 28-29.
[53] Lobotka: Presentation SECRET MATERIALS Festival fyziky 2011 – Tvorivý učiteľ fyziky, Smolenice 12.4.2011

### ii. Summary of outreach activities

| Popularisation of science | 2007 | 2008 | 2009 | 2010 | 2011 | total |
|---|---|---|---|---|---|---|
| articles in press media/internet popularising results of science, in particular those achieved by the Organization | 5 | 6 | 1 | 3 | 3 | 18 |
| appearances in telecommunication media popularising results of science, in particular those achieved by the Organization | 2 | 2 | 2 | 0 | 1 | 7 |
| public popularisation lectures | 0 | 9 | 1 | 3 | 8 | 21 |

### iii. Supplementary information and/or comments on popularisation activities

The most important event amongst popularization activities was annual Day of Open Doors of the Institute. The aim of the activity was to attract young people for the study in physics and electrical engineering. We received each year more than 150 young students thanks to our traditional contacts with teachers from colleges and technical schools. Several demonstration stands focused on material science, microelectronics and superconductivity are prepared every year for this event.

## 8. Background and management. Staffing policy and implementation of findings from previous assessments

### i. Summary table of personnel

| Personnel | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| all personnel | 125 | 123 | 124 | 122 | 121 |
| research employees from Tab. Research staff | 77 | 77 | 74 | 75 | 80 |
| FTE from Tab. Research staff | 58,36 | 55,02 | 58,77 | 63,63 | 60,58 |
| average age of research employees with university degree | 45,15 | 45,45 | 47 | 47,2 | 46,9 |

**ii. Professional qualification structure**

| Number of | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| DrSc. | 10 | 10 | 11 | 11 | 11 |
| Ia (vedúci vedecký pracovník/director of research) | 1 | 1 | 1 | 1 | 1 |
| IIa (samostatný vedecký pracovník/ senior scientist) | 19 | 18 | 17 | 20 | 23 |
| PhD / CSc. | 23 | 20 | 23 | 24 | 17 |
| prof. | 0 | 1 | 1 | 0 | 0 |
| doc./Assoc. prof. | 6 | 4 | 5 | 5 | 5 |

**iii. Status and development of research infrastructure incl. experimental, computing and technical base (description of the present infrastructure, premises, and material and technical resources. Infrastructure, instrumentation and major technical equipment necessary for the achievement of the objectives specified in the research Concept)**

Since 2009 Slovakia began to use structural funds from the EU. Activities of the Institute were focused on the Research and Development Operational Programme funded by the European Research and Development Fund. This programme is aimed at the improvement of research infrastructure. The Institute has been involved in the projects of the Operational Programme as a co-ordinating institution of the projects Centre of Excellence for New Technologies in Electrical Engineering (projects CENTE I and CENTE II). The Institute also participated in projects focused on the energy and transfer of technology (HD Video). Table 1 summarizes procured equipments within the project of structural funds in the assessed period 2007-2011. The total price for procured equipments is 2.618.835 Eur. Procured equipments substantially improved research infrastructure of the Institute.

In 2007 small clean room with area of 55 $m^2$, class 100 – 10 000 was constructed at the Institute from its own resources. Optical lithography and high vacuum evaporation equipment are located in the clean room. Nearly complet pilot line for semiconductor devices processing was builded up in the Institute, except new dry etching equipment.

In 2009 reconstruction of helium recovery system was realised. Since 2010 the Institutes receives regularly liquid helium from Technical University Wien based on agreement with very favourable conditions.

Table 1. List of procured equipments from structural funds.

| Equipment | Description | SF Project | Price [Eur] |
|---|---|---|---|
| Quanta 200 3D | Dual microscope with a focused ion beam (FIB) | CENTE I | 693.753 |
| ORION-8E | high vacuum evaporation unit | CENTE I | 295.425 |
| Beneq 200 TSF | atomic layer deposition unit | CENTE II | 350.500 |
| PVD products MBE/PLD-2000 | pulsed layer deposition unit | CENTE II | 330.600 |
| QD-PPMS-14 | Physical properties measurement system | CENTE II | 538.700 |
| INSPECT F 50, ELPHY Quantum | scanning electron microscope with electron beam lithography | HD Video | 232.000 |
| Keithley 4200, probe station | Semiconductor characterization unit | HD Video | 177.857 |

**iv. Status and development of bibliographic resources, activities of the Organisation's library and/or information centre**

Sources:

| | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| Books | 7042 | 7217 | 7235 | 7257 | 7266 |
| Serials | 15 | 16 | 16 | 16 | 16 |

The number of serials is low because our employees make use of on-line accesses to databases provided by the Central Library SAS and CVTI SR.

Services and activities:

- borrowings
- bibliographic information
- contributing to the central evidence of publication of SAS (EPCA) – 2930 entries
- contributing to the electronic book catalog (ARL – on-line access) – 2544 entries
- registering of the Institute's publications and citations
- updating of the Institute's web-page

**v. Describe how the results and suggestions of the previous assessment were taken into account**

Main suggestions of the previous assessment were summarized as follows:

- To keep and improve cooperation with universities in order to increase number of diploma works and PhD students;
- To continue in supporting applied research in cooperation with external environment;
- To increase popularisation;
- In particular in the field of nanomaterials it is recommended to implement new technologies and develop corresponding methodology in the field of electron beam lithography, lithography by focused ion beam as well in the field of high resolution electron microscopy. Effort to continue in promising results in the field of applied superconductivity requires new helium liquifier.

Response to the suggestion of the previous assessment:

- 47 diploma works lead by researchers of the Institute were performed within the assessed period, i.e. about 9 diploma works per year in average. According the rules the Institute the number of students is limited to 12 PhD students. Nearly maximum PhD students were trained each year during the assessed period. In 2011 we trained 16 PhD students within the Institute, as we received agreement with an exception from the Presidency of SAS and 1 PhD student was supported from our own resources.
- Attention of the Institute in the field of applied research was paid to research projects, in particular to the projects of the EU Framework that included industrial partners. It constituted main activity in the field of applied research. The total income of the Institute from these projects exceeded 1 mil. Eur. The total revenues from the contracts with industrial partners (not research projects) reached 141 657 Eur during the whole assessed period. The total income both from the applied research projects and contracts indicates that applied research was important activity of the Institute during the assessed period.
- Popularisation activities were focused to the organization of the annual Day of the Open Doors of the Institute. In addition up to various 50 activities (lectures, papers, interviews etc.) aimed to the increase of public awareness on semiconductor and superconductor application was performed during the assessed period.
- During the period 2007-2011 we have build up several new technologies to speed up progress in nanomaterial research: electron beam lithography, focused ion beam lithography, new advanced deposition techniques such as atomic layer deposition, pulsed laser deposition. New electron microscope with a resolution of 2 – 3 nm was installed at the Institute. Regular supply of liquid helium is provided based on agreement with the Technical University Wien under favourable conditions.

### vi. Supplementary information and/or comments on management, research infrastructure, and trends in personnel development

Research teams within the Institute are organised in research departments. The research departments present relatively independent unit, able to apply for projects on national and international level. The leaders of the departments manage the research activity within the unit and they are responsible for involvement of the department in national and international projects.

The Institute organizes each year internal evaluation of research activity of scientific departments. During the evaluation seminar subject of the research of particular department is open for discussion. Lot of interesting ideas emerged in the discussions during these

seminars. Finally, research activity of individual researches is evaluated once per year in order to evaluate their individual contribution.

**9. Supplementary information and/or comments important for the assessment of organisation which are not explicitly mentioned in the questionnaire (concerning each previously mentioned evaluation criteria, facts not included, evaluation of research teams by ARRA, etc.)**

The team lead by doc. Ing. F. Gömöry, DrSc. (Ing. J. Šouc, CSc., Ing. M. Vojenčiak, Phd., Dr. E. Pardo, Ing. L. Frolek and Mgr. E. Seiler, PhD.) was selected as a top SAS team in Engineering by ARRA agency in the period 2001-2010.

The team of Ing. Fröhlich, DrSc. (RNDr. K. Hušeková, Ing. K. Čičo, PhD., doc. RNDr. E. Dobročka, CSc., Ing. J. Kuzmík, DrSc., Ing. A. Rosová, CSc., Ing. D. Machajdík, CSc., Ing. B. Hudec + Ing. M.Ťapajna, PhD., Ing. R. Lupták, PhD.) was identified as a top SAS team in Materials Science by ARRA agency in the period 2001-2010.

Research team lead by Ing. P. Kováč, DrSc. (Ing. I. Hušek, Ing. T. Melišek, Ing. M. Kulich, PhD, Ing. J. Pitel, CSc., Mgr. T. Holúbek, PhD. and Mr. L. Kopera) was selected as above average research SAS team in Materials Science by ARRA agency in the period 2001-2010.

## Other information relevant to the assessment