Questionnaire

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

Period: January 1, 2003 - December 31, 2006

I. Formal information on the assessed Organisation:

1. Legal name and address

Institute of Electrical Engineering SAS
Dúbravská cesta 9
841 04 Bratislava
Slovak Republic

2. Executive body of the Organisation and its composition

Directoriat	name	age	years in the position
director	Ing. Karol Fröhlich, DrSc.	52	5
deputy director	RNDr. Vladimír Cambel, CSc.	51	3
scientific secretary	RNDr. Marianna Španková, PhD.	37	1

Deputy director – Ing. Fedor Gömöry, DrSc. 2002 - 2005
Scientific secretary – RNDr. Vladimir Cambel, CSc. 2002-2005

3. Head of the Scientific Board

Ing. Štefan Chromik, DrSc. 2006 -
RNDr. Martin Moško, CSc. 2002 – 2006

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 2003, 2004, 2005, 2006 and average number during the assessment period

See the first row of the Table in ii.

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

Research staff	2003		2004		2005		2006		average	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
Institute of Electrical Engineering	58	52.55	61	52.21	62	53.54	65	57.19	61.5	53.873
Dept. of Thin Oxide Films	6	5.55	7	4.6	9	5	9	7.75	7.75	5.725
Dept. of Optoelectronics	9	8.6	12	10.66	12	11.2	12	10.2	11.25	10.165
Dept. of Semiconductor Technology and Diagnostics	6	5.75	6	5.75	6	5.75	7	6	6.25	5.8125
Dept. of Superconductor Physics	8	8	8	8	9	8.33	9	7.53	8.5	7.965
Dept. of Cryoelectronics	7	6.25	8	6.6	7	6.6	8	7.11	7.5	6.64
Dept. of Microelectronic Structures	6	5.75	5	3.85	4	3.6	4	3.6	4.75	4.2
Dept. of Theory of Semiconductor Microstructures	3	2.65	3	2.75	3	3	4	3	3.25	2.85
Dept. of Superconductor Electrodynamics	9	6	8	6	6	5.15	7	7	7.5	6.0375
Dept. of Superlattices	4	4	4	4	6	4.91	5	5	4.75	4.4775

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 2003, 2004, 2005, 2006, and average amount for the assessment period

Salary budget	2003	2004	2005	2006	average
total salary budget (millions of SKK)	21.567	22.527	22.723	23.815	22.658

6. **URL of the Organisation's web site:** http://www.elu.sav.sk/

[1] Sum of the brutto salaries without the fund contributions.

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 Institute is focused on study in the field of physical, material and technical research of semiconductors and superconductors oriented toward:
   - theoretical and experimental study of mechanism of electrical charge transport in semiconducting structures and two-dimensional systems, in strong correlated and weak superconductors, including multilayered and mesoscopic systems,
   - preparation of superconducting materials and preparation of semiconducting films and heterostructures,
   - theoretical and experimental study of properties of superconducting devices and phenomena in these devices.

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.

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)

Research at the Institute is focused on actual problems in solid-state physics, microelectronics and electrical engineering. It can be classified into several domains, which are mutually interconnected:

- Study of selected theoretical problems of solid state physics focusing to potential applications in modern nanoelectronic devices and superconductivity.
- Research of new materials and technologies for information technologies, microelectronics and electric power devices.

- Characterisation and application of new structures for sensors and advanced microelectronic devices.
- Applied superconductivity.

Quality of the research at the Institute and its appropriate and promising orientation can be benchmarked by number of publications in international scientific journals, number of citations and by involvement in domestic and international research and technology development (RTD) projects. As very important output we consider successful participation in 7 projects within the 5th Framework Programme (3 RTD projects). In the 6th Programme research groups from the Institute was included in 7 projects (3 Specific Targeted Research Projects, STREP).

Besides the RTD projects the Institute was involved also in network program. Since January 1, 2003 the Institute started its activity as a Centre of Excellence "Applied Superconductivity Training and Research Advanced Centre, ASTRA" under the umbrella of European Commission. Acquisition of the grant for the Centre of Excellence we understand as an appreciation of quality of scientific research performed by the Institute in the field of applied superconductivity in Europe. Twinning with University of Twente, Enschede, within the project resulted in several visits and stays of students (pre-graduate and PhD) from the IEE SAS at the University of Twente. Three international events were organised within the ASTRA project: "Workshop on low T_c and high-T_c superconductors in power applications", held on April 15-16 2003 in Bratislava, workshop on "Superconductivity in European power applications", held in Bratislava on April 20 2004 and "Workshop on Weak Superconductivity" as satellite to the European Conference on Applied Superconductivity, held on 16-19 September 2005 in Bratislava. Several high ranking scientists have visited Institute within the ASTRA project. During the project Consulting Centre in Applied Superconductivity, available on the web-site address http://www.astra.sav.sk/cs.html, was created. After termination of the project, the Consulting Centre continues its activity. Indirect continuation of the ASTRA project is Maria Curie Training Network project "Nano-Engineering Superconductors for Power Applications", NESPA, gathering together 13 partners from Europe. The Project started at the end of 2006.

During the period 2003 - 2005 the Institute was involved together with other institutes of the Slovak Academy of Science into the national governmental project "New materials and devices in sub-micrometer technology". Within the project, the Institute was responsible for the Part 02 "Application of sub-micrometer technologies to preparation of electronic, magnetic and electro-mechanical devices of new generation". Several groups from 5 research departments of the Institute took part in the project. New devices such as quantum structures for quantum Hall effect, quantum well infrared photo detectors, sub-micrometer micro-electro-mechanical systems, sub-micrometer Hall sensors, MOS structures for sub-100 nm CMOS technology and sub-micrometer junctions for SQUID were developed in the frame of the national governmental project.

Since 2005 the Institute holds the title Centre of Excellence SAS in the field of advanced devices in electronic and electrical engineering, CENG. Partners in the Centre are Faculty of Electrical Engineering and Information Technology, Slovak University of Technology, Dept of Physics, and Faculty of Mathematics and Physics, Comenius University, Dept. of Experimental Physics. Research within the Centre is oriented into three main directions:

- information technology,
- energetics and power engineering,
- development of new devices and sensors.

Activity of the Centre is described in the web-site: http://www.ceng.sav.sk/. In 2006 a seminar of the Centre was organized. In the frame of the seminar award to the most successful

works of young researchers was given. Since its beginning more than 30 publications were published in the research field of the Centre.

Institute received support from the European Social Fund in the frame of the project "Educational Centre of Information Technologies and Power Engineering" for the period from September 2005 till February 2008. Support from the European Social Fund is transmitted mostly to young researchers, pursuiting their carrier in research. Information on the project can be found on the following web-site: http://www.elu.sav.sk/vcite/intro_sk.html.

Selected theoretical problems of solid-state physics

The research activities of the Institute in the solid state physics and physics of advanced microelectronic devices were aimed at the analysis of the two-dimensional and one-dimensional electron transport in the A^{III}-B^{V} semiconductor heterostructures - in the quantum wells and quantum wires. In addition, basic principles of superconductivity were analysed. Results of theoretical studies serve as a base for research of new materials and technologies.

Coherent metallic resistance and medium localisation in a disordered one-dimensional insulator was described in the paper published in Phys. Rev. Lett. **91** (2003) 136803. According to the strong localization theory, a disordered one-dimensional wire with coherent electronic conduction is an insulator with the mean resistance and resistance dispersion both growing exponentially with the wire length - localization length ratio. We have shown theoretically that this one-dimensional insulator undergoes at full coherence the crossover to a one-dimensional "metal", caused by thermal smearing and resonant tunnelling. As a result, the resistance dispersion becomes wire length independent and smaller than unity, while the mean resistance grows with the wire length - localization length ratio linearly and eventually polynomially, manifesting the so-called medium localization. A comparison with experiment has been demonstrated.

Coherent resistance of a disordered one-dimensional wire with expressions for all resistance moments and with evidence for the non-Gaussian distribution was described in Phys. Rev. B **67** (2003) 165316.

In spite of many experimental and theoretical efforts, basic understanding of the mechanism enhances the critical temperature of the high-T_c superconductors is still incomplete. Within the monograph "Models and methods of high-T_c superconductivity", Nova Science Publishing 2003, we have published a chapter focused on the effect of singularities in the density of states (DOS) on the critical temperature and energy gap. According to our work, the van Hove scenario can explain to a large extent the existence of the high-T_c values, doping dependence and many other properties of the normal and superconducting state of the high-T_c superconductors.

New materials and technologies

Subject of material research at the Institute during the period 2003 – 2006 were III-V and III-N semiconductors, superconducting materials (thin films, composite superconductors), nanostructured materials, and materials for application in advanced microelectronics (thin oxide films).

Metal-organic chemical vapour deposition (MOCVD) was used for preparation of new structures and devices based on A^{III}-B^{V} semiconductors. In combination with standard deposition non-planar technology was developed, consisting of patterning of 3-dimensional objects using wet etching and successive thin film deposition. Technology is suitable for preparation of micro-electromechanical systems (MEMS) based on III-V semiconductors. In

addition, electronic properties and phase separation of MOCVD grown $In_xGa_{1-x}P$ alloy were analysed. Recently, properties of new emerging materials from III-N group were analysed.

New gallium phosphide grown by vertical gradient freeze method was used for light emitting diodes in the 5th FP project abbreviated VGF (IST-2001-32793). The central activity of the project was the synthesis and the growth of GaP single crystals and this task was carried out by Slovak industrial SME company PHOSTEC. Our contribution to the project was testing of the substrates by metal organic vapour phase epitaxy (MOVPE) and development of structures for light emitted diodes (LED). Within the project the high efficiency InGaP LED's were prepared on GaP substrates by MOVPE using graded buffer structure. Excellent cooperation between partners led to the decision to continue common work within a new EUREKA project.

Important part of the research activity was directed toward the study of properties and preparation of superconducting films and composite conductors. Very soon after discovery of superconductivity in MgB_2 we have succeeded in preparation of thin MgB_2 films. In the recent period, a progress toward the application of MgB_2 films in Josephson junction was achieved. Original results were obtained, allowing reproducible preparation of high-quality MgB_2 films on poly-crystalline Si, single-crystalline SiC, and on amorphous buffer SiC layer on Si (100). Electrical and structural properties of MgB_2 films prepared by sequential deposition of B and Mg on Si substrates with NbN buffer layer was described in J. Appl. Phys. **96** (2004) 4668. It was shown that application of the NbN buffer layer deposited at room temperature and *in-situ* preannealed results in improved superconductivity and transport properties.

Significant progress was achieved also in the understanding of basic phenomena in structures with classical low temperature superconductors. We have observed coexistence of 0 and π states in Nb-$Fe_{0.1}Si_{0.9}$-Nb Josephson junctions with a paramagnetic insulating barrier formed by amorphous $Fe_{0.1}Si_{0.9}$, Phys. Rev. B **74** (2006) 020502(R). The simultaneous presence of both 0 and π phases in the Nb-$Fe_{0.1}Si_{0.9}$-Nb junctions has been interpreted in terms of the vortex state model, proposed by Bulaevskij et al.

In the field of applied superconductivity, composite MgB_2/Fe superconductors were developed at the Institute, when properties of as-deformed and post-annealed MgB_2/Fe composite wires were studied, Supercond. Sci. & Technol. **16** (2003) 292. Subject of the research in the field of MgB_2 composite superconductors was to increase the critical current density by introducing effective pinning centres (Sci. & Technol. **17** (2004) 1225). MgB_2 composite superconductors prepared at the Institute has parameters fully comparable with the best samples in Europe and United States, Sci. & Technol. **18** (2005) 856. We have found that substantial increase of the critical current density (3.6 times in magnetic field of 5T at the temperature of 4.2K) can be reached if fine metallic particles with good electrical and thermal conductivity (W, Hf,...) are inserted in the superconducting core. Along with the expected gettering effect on impurities (oxygen in the first instance), the stability of current transport was improved as well. This result is significant for further development of MgB_2 composite wires in the 6th Framework Programme project NMP3-CT-2004-505724 with the acronym HIPERMAG.

The aim of the HIPERMAG project is to develop high current density in thermally stable MgB_2 composite superconductor, which would be able to replace the low temperature NbTi or possibly Nb_3Sn. The group from the Institute has developped and successfully used chemically inert and non magnetic sheath materials (Ta, Nb and Ti) in MgB_2 composite wires made by *ex-situ* and *in-situ* techniques. Optimized deforming process combined with the fine-grain mechanically alloyed precursor powders allowed to prepare fine filamentary MgB_2 composite with the minimum filament size of 13μm. Improved thermal stability was

measured for multi-core MgB_2 wire consisting of filaments protected by Ti barrier, oxygen-free high conductive copper stabilizer and mechanically strong Monel 400 outer sheath.

Transport properties (critical current, a.c. losses) of high-T_c superconductors can be increased by appropriate geometry or in combination with ferromagnetic materials. We have experimentally tested theoretical prediction of estimation of a.c. losses in multifilamentary tape in an applied external field. The calculations showed, that the structure of low loss tape should provide enough channels parallel to the applied filed, to allow easy penetration of magnetic flux. The lowest losses have been measured in the tape with filaments arranged in parallel to the external field, Supercond. Sci. & Technol. **17** (2004) S150. Recently we have shown that the self-field critical current of high-T_c superconducting tape can be improved by the edge cover from soft ferromagnetic materials (Appl. Phys. Lett. **89** (2006) 072506).

In the last period attention was paid also to development of nanocomposite materials with metallic component - nanosized grains embedded in insulating matrix. Using this approach we tried to control material properties on nano-size level to achieve new properties (e.g. enhanced magnetoresistivity at room temperature, mechanical and superconducting properties). We have examined structural, electrical and magnetic properties of carbon-nickel composite films (Carbon **43** (2005) 2192). Properties of these insulator-metal composite thin films (tunnelling determined transport, anisotropic magnetoresistivity) were related to the structure on nanometre scale level. Interesting vortex behaviour was observed in superconducting NbN-AlN multilayered nanocomposite, Supercond. Sci. & Technol. **19** (2006) 612. The nanocomposite behaved like a 2D system with transition to superconducting state close to 6 K. Current voltage characteristics in the vicinity of the transition exhibited negative differential resistivity, thereby generating electromagnetic waves.

Thin oxide films were subject of research due to their potential application in new sub-100 nm complementary metal-oxide-semiconductor (CMOS) devices. New modification of metal-organic chemical vapour deposition (MOCVD) was developed in collaboration with French laboratory LMGP, Grenoble and AIXTRON A.G. company, Germany. The technology is based on computer-controlled delivery of solution, containing necessary metal-organic precursors. The method is suitable for preparation of a wide variety of thin dielectric oxide films (Al_2O_3, Gd_2O_3, La_2O_3), conducting oxide films (RuO_2, $SrRuO_3$, $LaSrCoO_3$), noble metals (Ru) and conducting nitrides (TiN, TaN). In the period 2004-2006 we have developed MOCVD process for application of electrodes and high-k dielectrics within the cooperation contract with the AIXTRON A.G., Germany. The total income of the contract was 60 000 €.

Advanced microelectronic structures and devices

Preparation, characterisation of properties and application of new microelectronic structures and devices was based on results obtained in material research within the Institute.

Properties of advanced metal-oxide-semiconductor (MOS) structures for sub 65 nm silicon CMOS technology node, were studied during the assessed period. The MOS structures were prepared by MOCVD in the Institute or in collaboration within the INVEST (5^{th} FP, Integration of very high-k dielectrics for silicon technology, INVEST) project. Work function of Ru-based gate electrodes prepared on several gate dielectrics was evaluated (Mat. Sci. Engn. B **109** (2004) 117). As a result of the project, we have demonstrated possible application of Ru and $SrRuO_3$ gate electrodes for MOS field effect transistors with equivalent thickness of the HfO_2 gate oxide of about 2 nm. In the gate stack Ru/Hf-Si-O/Si we have precisely measured work function and using results of X-ray photoelectron spectroscopy and electron energy loss spectroscopy we have determined energetic band structure of the structure. We have found that fixed charges in the Hf-Si-O dielectric film can be effectively

modified using post-deposition annealing in the 10% H_2 + 90% N_2 mixture (forming gas), J. Electrochem. Soc. **153** (2006) F176. The Ru/Hf-Si-O/Si gate stack is stable under rapid thermal annealing up to 900 ^oC.

Design and development of GaAs heterostructure based micro-electro-mechanical system (MEMS) for microwave measuring device was object of the NATO SfP project which finished on November 2004. Within this project, new GaAs micromachining approaches compatible with GaAs heterostructure fabrication techniques were introduced. The main goal was to integrate GaAs HEMT's with GaAs micromechanical structures and controlled circuits in fully monolithic integrated approach to produce "single chip" power sensor of high electro-thermal performance.

Various approaches and design concepts in the field of 3D thermo-mechanical modelling and simulation were introduced and directly compared with comprehensive experimental electro-thermo-mechanical characterisation of MEMS devices in the chapter of monograph "MEMS/NEMS handbook: techniques and applications" issued by Springer in 2005. Chapter "Gas thermally based MEMS devices: fabrication techniques, characterisation and modelling" describes also experience of the group of the Institute in development of advanced MEMS device.

Scanning Hall probe microscope (SHPM) has been designed at the Institute. Fabrication of a vector Hall sensor for magnetic microscopy was described in Appl. Phys. Lett. **82** (2003) 3704. It represents an important imaging tool used for detailed studies of superconductors in basic science and in the industrial sector. It can be applied for the studies of losses, current distribution, and effects at grain boundaries. We have developed a large-scale low-temperature SHPM for imaging the entire magnetic field in close proximity to magnetic and superconducting samples at 4.2 – 300 K. The microscope combines a large scanned area and high spatial and magnetic field resolution. The instrument is designed as an insert of standard helium flowing cryostats and is based on advanced low-noise Hall sensor fabricated at the Institute. The microscope was used for MgB_2 filament characterization. It was shown that local critical currents in the MgB_2 samples could be estimated. Moreover, it indicates the microstructure and space homogeneity of the superconductor.

In the last year we began the study of properties of GaN-based structures for the high power application in microwave range. Conductivity and Hall effect of free standing highly-resistive epitaxial GaN:Fe substrates were described in Appl. Phys. Lett. **85** (2004) 5616. Progress in processing of Ga-N based structures and devices achieved in the last period was summarized in the chapter of Handbook of Semiconductor Nanostructures and Nanodevices, Vol. 3: Spintronics and Nanoelectronics 2006, p. 95. Important issues of Ga-N based high electron mobility transistors performance such as effect of passivation on transistor properties were addressed. Effort in the last period was devoted to the improvement of GaN based high electron mobility transistor (HEMT) by incorporation of gate insulating layer. First promising results describing properties of MOS heterostructure field effect transistor with SiO_2 insulating layer were published in Appl. Phys. Lett. **87** (2005) 143501. Obtained improved transistor characteristics indicate prospect of this approach.

Study of physical properties of semi-insulating A^{III}-B^V semiconductors resulted in the development of advanced X-ray detectors. The role of electrode technology in radiation detector based on semi-insulating InP was described in publication Nucl. Instr. & Methods in Phys. Res. A **531** (2004) 181. Monolithic strip line X-ray detector was used as a sensor in the digital X-ray scanner which was developed in collaboration with a small Slovak company T&N System, Ltd. Banská Bystrica within the project "Modular imaging X-ray system utilizing radiation detectors based on GaAs semiconductor compound", funded by the Slovak Ministry of Industry. The digital X-ray scanner was awarded at the international trade fair Incheba, Bratislava 2004 by the Gold Incheba award.

As a next step, successful realization of the portable digital modular X-ray scanner based on application of monolithic X-ray GaAs line detectors was achieved within the project "A new generation digital radilogy kit" funded by APVV within the call Transfer. Several Slovak small and medium enterprises (MTS joint-stock company, T&N System, Ltd.) took part in the project. Developed digital modular X-ray scanner is an unique radiographic equipment where X-ray imaging is realised in quantum mode („single photon counting") allowing substantial improvement of the image in contrast. Following our knowledge, this instrument is the first in the word with applied GaAs detectors of X-rays. Preliminary test of the detectors shows high quality of X-ray images.

The special modular power opto-couplers were designed and developed in cooperation with NES Nová Dubnica as an industrial partner. These power opto-couplers were designed to serve as an isolated power supply for small special electronic systems (communications units, safety systems or starting units). Basic module is designed for output power of 100 mW and isolation voltage up to 22 kV. To allow the direct loading from high voltage sources the light emitting devices on the input side are in serial connection. The project ended in March 2003. The total revenue of the project was 500 000 Sk.

Applied superconductivity

Important part of superconductivity research is focused to application of high-T_c superconductors for energy transformation and transmission. In cooperation with research groups from Skoda Vyzkum Plzen, Czech Republic, University of Wuppertal, Germany and Cryoelectra Wuppertal Germany we designed, manufactured and tested several models of 14 kVA transformer with superconducting winding made of superconducting tape Bi-2223/Ag. We demonstrated that this type of superconductor can be successfully applied in the transformer windings and its use results in a considerable decrease of AC losses compared with conventional windings. These activities were performed within the NATO Science for Peace program, under the project NATO SfP-974124.

The models of superconducting cables were constructed on the basis of Bi-2223/Ag tapes (Pb-Bi-Sr-Ca-Cu-O superconductor) and $YBa_2Cu_3O_7$ coated conductor. The experiments were carried out within the 5th Framework Programme project "Q-SECRET"(Bi-2223/Ag conductor based cable, 1st generation of high-T_c conductor) and within the 6th Framework Programme project "SUPER 3C" (YBCO coated conductor based cable, 2nd generation of high-T_c conductor). Significant improvement in understanding of electrical measurement of a.c. losses in superconducting transmission cable has been achieved by analysis of non-uniform current distribution, Supercond. Sci & Technol. **18** (2005) 780. Experiments demonstrated that the variation in contact resistance is the most critical factor in testing short cables.

In the frame of international project Euratom/EFDA FU06-CT-2003-00041 we developed, manufactured and tested measuring systems with low temperature Hall Probes for current distribution measurements in superconducting cables in fusion equipment. To design distribution and orientation of Hall probes we collaborated with the Second University, Naples, Italy. The measuring systems were calibrated, tested and installed in experimental facilities in Karlsruhe (TOSKA) and in the measuring device developed at Tesla Engineering, UK, for SULTAN (PSI Villigen, Switzerland). Measurements showed that the current redistribution in the cables started about 200 seconds before quench of the magnet. This effect is of great importance for superconducting magnets stability.

We have performed theoretical analysis and estimation of alternative current losses in the superconducting coil of Stellarator, fusion equipment, constructed at the IPP Greifswald, Germany. The losses occur during energizing the main magnetic field in the Stellarator

machine. Finite element simulations have been used to determine typical transient of magnetic field that could be expected in the equipment due to mechanical movement. We found that maximum dissipation connected with one event is tolerable for the magnet design. Theoretical estimation of electromagnetic loss from the movement of superconducting coil in the W7-X Stellarator was described in IEEE Trans. Appl. Supercond. **16** (2006) 123.

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 four main domains:

- Selected theoretical problems of solid state physics focusing to potential applications in modern nanoelectronic devices and superconductivity.
- Research of new materials and technologies for information technologies, microelectronics and electric power devices.
- Characterisation and application of new structures for sensors and advanced microelectronic devices.
- Applied superconductivity.

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

In the domain of solid state physics we will focus on electron transport in mesoscopic structures that can be understood as a model for the simplest electronic circuit. Mesoscopic electron transport in very thin conducting wires which are shaped as circular rings with both wire ends tied to each other was intensively studied during past fifteen years. However, measurements of persistent currents in disordered metallic ring are so far understood only qualitatively: there is an order of magnitude disagreement between the theory and experiment. This problem motivates a lot of research work focused on the interplay of the electron-electron interaction and disorder. Another problem concerns the role of electron decoherence due to the electron-electron interaction. The question of great interest for the basic research is whether the decoherence exists at zero temperature or not. The question of practical interest is how to suppress the decoherence in situations where the electron coherence is an underlying principle of the device, like for example the quantum bit.

Research of new materials for information technologies and microelectronics is driven by the development of new technological processes. Advanced thin film technologies like atomic layer deposition, metal organic chemical vapour deposition and pulsed laser deposition are nowadays applied in micro- and nano-electronics research and industrial applications. These

techniques are reproducible, versatile and capable to control structure on nanometer scale. Further development of thin film growth of semiconductors, insulators and superconductors is prerequisite for further advance of devices. Recently, vacuum deposition techniques have been adapted to prepare nanostructured thin films. Nanostructured films offer properties significantly different from those of standard thin films.

New materials and technologies are actually used to define novel structures for sensors, advanced microelectronic and optoelectronic devices, as well as for power devices. A part of these devices is based on nanocomposite and nanostructured materials, prepared by novel nanotechnologies. Such devices include micro and nano- electro mechanical systems (MEMS-NEMS), active tips for scanning probe microscopy, high-electron mobility transistors based on AlGaN/GaN and InAlGaN/(In)GaN heterostructures, and also InGaP/AlGaAs/GaAs-based high-sensitive sub-micrometer Hall probes for magnetic field imaging. Functional oxides will be introduced to novel microelectronic devices to increase their performance. Moreover, devices based on combined semiconductor – superconductor heterostructures are intensively studied.

For the sensor design and characterization, new techniques have to be developed also, at the Institute. We suppose that techniques such as focused ion beam, scanning electron microscope with electron lithography, high resolution TEM, low temperatures (~ 100 mK), etc. will be available at the Institute or in its close proximity. For these novel structures and devices also the methodology of characterization and testing has to be, at least partially, developed. We suppose high application potential of the proposed devices and sensors in medicine, automobile industry, and in general for the inspection of the quality of life.

In the field of applied superconductivity the long-standing European related research ranges from fundamental science to development and commercialisation of superconducting systems (manufacturers of “bare” magnet systems, of complete MRI and NMR systems and of various electro-technical applications like coils, transformers, cables etc.). This existing basis of scientific and technical excellence is strongly multidisciplinary, since successfully optimising a superconducting material, developing it in conductor form, and applying it in a superconducting device requires continuous feedback between basic material science, chemistry, physics and electrical engineering. Superconductors are thus truly higher added value products whose successful development and production requires knowledge-based approaches.

The research in applied superconductivity is going in two parallel paths: in the field of low temperature superconductivity (LTS) and in the field of high temperature superconductivity (HTS). Low temperature superconductors are commercially available in large scale and widely used in superconducting magnets for laboratory use, in medicine and for separation. Emerging material in this class is MgB_2 and therefore research should be focused on improvement of MgB_2 transport properties, stability, conductor design and on decreasing of a.c. losses.

HTS conductors are up to now confronted with technological obstacles resulting in high price. Nevertheless they found first applications in energy transport (superconducting cables, transformers), at least on demonstrational level. Superconducting tapes Bi-2212 were used in windings of inserts into large magnets to achieve record magnetic field 25T. Very promising are second generation superconductors (YBCO, DyBCO,…) prevailing, mainly in current transport, properties of the conductors of first generation (e.g. Bi-2223/Ag). In our institute we participate in research oriented on preparation and application of these conductors in cables, coils and generators with high relation between power and mass.

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 and in applied superconductivity. The role of the Institute is to provide a backround infrastructure for the development. For further promotion of the research there is a need for new laboratories, equipments and high-quality research staff. In particular, building of new clean room with optical lithography and related patterning techniques is of crucial importance. To support research in low temperatures and for applied superconductivity modern He liquefier should be installed at the Institute.
The Institute has to maintain its leading position on national level in 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 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

Objectives of the concept are strongly related to the basic orientation of the Institute. Partial objectives can be expressed in the following points:

- Development of appropriate simulation methods of transport in mesoscopic structures, taking into account systems with and without electron-electron interactions.
- Development of advanced thin film technologies, in particular atomic layer deposition, metal-organic chemical vapour deposition, pulsed laser deposition etc.
- Preparation of functional oxide films and their application in semiconductor devices with the aim of increasing their performance.
- Development of technology of nanostructured thin films
- Complex study of the preparation, characterization, simulation and testing of semiconducting MEMS and NEMS structures and devices, active tips for scanning systems, and other novel devices developed at the Institute.
- Development of the methodology of electrical, mechanical and thermal characterization of the nano-scaled structures and devices.
- Methodology of micro-structural X-ray analysis using quantum X-CT and scanning.
- Design and testing of special sensors for neutron monitoring and imaging as well as hot-plasma diagnostics and X-ray spectroscopy.
- Realisation of high-speed photodetectors based on high Tc superconductors with critical temperature above 100 K.
- Development of technical superconductors based on MgB_2 as a conductor of choice in various applications, including MRI and NMR systems.

- Development of experimental methods for monitoring of superconducting wires, tapes and cables with respect to their losses, stability, current distribution and electric and thermal transport properties.
- Study of dissipative processes in superconducting windings at DC and AC conditions, close to real applications.
- Construction of stable superconducting windings for generation of magnetic fields, transformers, cables and generators with high relation between power and overall mass.

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

To achieve proposed concept of the research and to keep pace with leading research groups in the field throughout the Europe it absolutely necessary to innovate research infrastructure of the Institute. As a result of internal discussions, we have prepared a list of technological facilities necessary for further development of the Institute. New thin film technologies include atomic layer deposition, metal-organic chemical vapour deposition and laser deposition. We intend to built up and equip small clean room within the Institute with optical lithography laboratory including patterning technology. This facility will be shared with several groups from the Institute. New He liquefier is required for further development of the research at low temperatures and in applied superconductivity. The effort is actually concerted with other institutes of Slovak Academy of Science in order to prepare project of material research for application within structural funds. The project foresees important improvement of research infrastructure in the period 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 Forschungszentrum Julich, TU Wien, IMEC Leuven, IBM Zurich, Argonne Natl. Lab., MINATEC Grenoble, ICMAB Barcelona, ATOM Institut Vienna, …). 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. In 2006 we have entered to 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.

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 it is of advantage to cumulate effort of several groups 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.

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.

III. Partial indicators of the main activities:

1. Research output

[1] 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

2003

[1] MOŠKO, M. - VAGNER, P. - BAJDICH, M. - SCHAEPERS, Th. Coherent "metallic" resistance and medium localization in a disordered one-dimensional insulator. In *Physical Review Letters*. Vol. 91, (2003), p. 136803. IF: 7,33

[2] TAKÁCS, Silvester. Critical temperature and energy gap in superconductors with singularities in the density of states (DOS). In *Models and methods of high-Tc superconductivity*. New York : Nova Science Publishing, 2003. ISBN 1-59033-667-4. P. 289-316.

[3] GREGUŠOVÁ, D. - CAMBEL, V. - FEDOR, J. - KÚDELA, R. - ŠOLTÝS, J. - LALINSKÝ, T. - KOSTIČ, I. - BENDING, S.J. Fabrication of a vector Hall sensor for magnetic microscopy. In *Applied Physics Letters*. Vol. 82, (2003), p. 3704-3706. IF: 4,21

[4] KOVÁČ, P. - HUŠEK, I. - GROVENOR, Ch. - SALTER, Ch. Properties of as-deformed and post-annealed MgB_2/Fe(Fe-alloy) composite wires. In *Superconductor Science and Technology*. Vol. 16, (2003), p. 292-296. IF: 2,14

[5] VAGNER, P. - MARKOŠ, P. - MOŠKO, M. - SCHÄPERS, Th. Coherent resistance of a disordered one-dimensional wire: Expressions for all moments and evidence for non-Gaussian distribution. In *Physical Review B*. Vol. 67, (2003), p. 165316. IF: 3,33

2004

[6] CHROMIK, Štefan - GAŽI, Štefan - ŠTRBÍK, Vladimír - ŠPANKOVÁ, Marianna - VÁVRA, Ivo - BEŇAČKA, Štefan - VAN DER BEEK, C.J. - GIERLOWSKI, P. Electrical and structural properties of MgB2 films prepared by sequential deposition of B and Mg on the NbN-buffered Si(100) substrate. In *Journal of Applied Physics*. Vol. 96, (2004), p. 4668-4670. (2,171 – IF2003)

[7] KOVÁČ, Pavol - HUŠEK, Imrich - MELIŠEK, Tibor - GROVENOR, C.R.M. - HAIGH, S. - JONES, H. Improvement of the current carrying capability of ex situ MgB2 wires by normal particle additions. In *Superconductor Science and Technology*. ISSN 0953-2048. Vol. 17, (2004), p. 1225-1230. (2,247– IF2003)

[8] DUBECKÝ, František - BOHÁČEK, Pavol - ZAŤKO, Bohumír - SEKÁČOVÁ, Mária - HURAN, Jozef - ŠMATKO, Vasilij - FORNARI, R. - GOMBIA, E. - MOSCA, R. - PELFER, P.G. Role of electrode technology in radiation detector based on semi-insulating InP in development of detector array. In *Nuclear Instruments and Methods in Physics Research A*. Vol. 531, (2004), p. 181-191. (1,166 – IF2003)

[9] GÖMÖRY, Fedor - SEILER, Eugen - ŠOUC, Ján - KOVÁČ, Pavol - HUŠEK, Imrich - FARINON, S. - FABBRICATORE, P. - PERKINS, G. - CAPLIN, A.D. - PARDO, E. - SANCHEZ, A. - NAVAU, C. Influence of filament arrangement on current distribution and AC loss in Bi-2223/Ag tapes. In *Superconductor Science and Technology*. Vol. 17, (2004), p. S150-S154. (2,247– IF2003)

[10] KORDOŠ, Peter - MORVIC, Marian - BETKO, J. - NOVÁK, Jozef - FLYNN, J. - BRANDES, G. Conductivity and Hall effect of freestanding highly-resistive epitaxial GaN:Fe substrates. In *Applied Physics Letters*. Vol. 85 (2004), p. 5616-5620. (4.31 - IF2004).

[11] FRÖHLICH, Karol, HUŠEKOVÁ, Kristína, MACHAJDÍK, Daniel, Hooker, J.C., Perez, N., Fanciulli, M., Ferrari, S., Wiemer, C., Dimoulas, A., Vellianitis, G., and Roozeboom, F. Ru and RuO_2 gate electrodes for advanced CMOS technology. In Materials Sci Engn. B Vol. 109 (2004) 117–121. (0,92-IF2004).

2005

[12] LALINSKÝ, Tibor - DRŽÍK, M. - JAKOVENKO, J. - HUSÁK M. GaAs thermally based MEMS devices: fabrication techniques, characterization and modeling. In Ed. LEONDES, C. T. *MEMS/NEMS handbook: techniques and applications*. Vol. 3. New York: Springer, 2005. ISBN: 0-387-24520-0. Chapter 3, p. 49-109.

[13] KORDOŠ, Peter - HEIDELBERG, G. - BERNÁT, J. - FOX, A. - MARSO, M. - LÜTH, H. High-power SiO_2/AlGaN/GaN metal-insulator-semiconductor heterostructure field-effect transistors. In *Applied Physics Letters*. Vol. 87, 2005, p. 143501-143504. (4.31 - IF2004).

[14] GÖMÖRY, Fedor - FROLEK, Lubomir - ŠOUC, Ján. Non-uniform current distribution as the cause of false voltage signals in the ac loss measurement on a superconducting cable. In *Superconductor Science and Technology*. Vol. 18, (2005), p. 780-790. (1.56 – IF2004).

[15] KOVÁČ, Pavol - HUŠEK, Imrich - MELIŠEK, Tibor - ŠTRBÍK, Vladimír. Basic properties of rectangular MgB2/FeNiCo and MgB2/Fe wires made in situ. In *Superconductor Science and Technology*. Vol. 18 (2005), p. 856-860. (1.56 – IF2004).

[16] SEDLÁČKOVÁ, Katarína - LOBOTKA, Peter - VÁVRA, Ivo - RADNÓCZI, G. Structural, electrical and magnetic properties of carbon-nickel composite thin films. In *Carbon.* Vol. 43, (2005), p. 2192-2198. (3.33 - IF2004).

2006

[17] KORDOŠ, Peter. Material and device issues of AlGaN/GaN high electron mobility transistors. In BALANDIN, A.A. *Handbook of Semiconductor Nanostructures and Nanodevices*. Vol. 3: Spintronics and Nanoelectronics. Valencia: American Sci Publ., 2006. P. 95-152.

[18] FRÖHLICH, Karol - LUPTÁK, Roman - HUŠEKOVÁ, Kristína - ČIČO, Karol - ŤAPAJNA, Milan - WEBER, U. - BAUMANN, P.K. - LINDNER, J. - ESPINOS, J.P. Properties of Ru/HfxSi1-xOy/Si metal oxide semiconductor gate stack structures grown by atomic vapor deposition. In *Journal of the Electrochemical Society*. Vol. 153, (2006), p. F176-F179. (2.19 – IF2005).

[19] GÖMÖRY, Fedor. Improvement of the self-field critical current of a high-Tc superconducting tape by the edge cover from soft ferromagnetic material. In *Applied Physics Letters*. Vol. 89, (2006), p. 072506. (4.13 – IF2005).

[20] LOBOTKA, Peter - GAŽI, Štefan - VÁVRA, Ivo - SEDLÁČKOVÁ, Katarína - ŠATKA, A. - KOVÁČ, J. - HAŠKO, D. Vortex behaviour in a superconducting NbN-AlN multilayered nanocomposite. In *Superconductor Science and Technology*. Vol. 19, (2006), p. 612-617. (1.890 - IF2005).

[21] VÁVRA, Ondrej - GAŽI, Štefan - GOLUBOVIČ, J. - VÁVRA, Ivo - DÉRER, Ján - VERBEECK, J. - VAN TENDELOO, G. - MOSHCHALKOV, V.V. 0 and π phase Josephson coupling through an insulating barrier with magnetic impurities. In *Physical Review B*. Vol. 74, (2006), p. 020502. (3.19 – IF2005).

[22] GÖMÖRY, Fedor - TAKÁCS, Silvester - WERNER, A. - Sochor, M.: Theoretical estimation of electromagnetic loss from the movement of superconducting coil in the W7-X stellarator, In *IEEE Trans. Applied Supercond*. 16 (2006) 123-126. (1.08 – IF2005).

[2] List of monographs/books published abroad

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[3] List of monographs/books published in Slovakia

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[4] List of other scientific outputs specifically important for the Organisation

[1] Institute of Electrical Engineering Slovak Academy of Sciences. Biennial Report 1. January 2003 – 31. December 2004. Eds. V. Cambel et al. Bratislava: IEE SAS 2005. 114.

[5] 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).*

Research outputs	2003			2004			2005			2006			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
chapters in monographs, books published abroad	1	1/52.55	0.05	0	0.00	0.00	2	0.04	0.09	2	0.03	0.08	5	1.3	0.02	0.06
chapters in monographs, books published in Slovakia	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.0	0.00	0.00
CC publications	61	1.16	2.83	84	1.61	3.73	67	1.25	2.95	87	1.52	3.65	299	74.8	1.39	3.30
scientific publications indexed by other databases (Scopus)	3	0.06	0.14	2	0.04	0.09	0	0.00	0.00	14	0.24	0.59	19	4.8	0.09	0.21
scientific publications in other journals	0	0.00	0.00	1	0.02	0.04	3	0.06	0.13	2	0.03	0.08	6	1.5	0.03	0.07
publications in proc. of international scientific conferences	15	0.29	0.70	30	0.57	1.33	27	0.50	1.19	28	0.49	1.18	100	25.0	0.46	1.10
publications in proc. of nat. scientific conferences	10	0.19	0.46	6	0.11	0.27	7	0.13	0.31	12	0.21	0.50	35	8.8	0.16	0.39
active participations at international conferences	81	1.54	3.76	107	2.05	4.75	92	1.72	4.05	99	1.73	4.16	379	94.8	1.76	4.18
active participations at national conferences	5	0.10	0.23	13	0.25	0.58	0	0.00	0.00	13	0.23	0.55	31	7.8	0.14	0.34

[6] Renormalized publications[2]

Renormalized publications = number of CC publications in the given year times authorship's portion of the Organisation times the journal impact factor in 2005 divided by the median impact factor in the research field

Renormalised publications	2003			2004			2005			2006		
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget
Renormalized publications	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00

[7] Standard manuscript page count[3]

Standard manuscript page count	2003			2004			2005			2006		
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget
page count	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0

[8] List of patents and patent applications

[1] Dubecký, F., Darmo, J., Pelfer, P.G., Kordos, P., and Förster, A.: *Detector of ionising radiation and methods of its preparation*, ČPV: PP 0538-95, ČP: P 282934

[2] Chromik, Š., Vincenc Oboňa, J.: *Using of the C60 resist mask in the process of superconducting thin film patterning in cryoelektronics,* No. 5101-2005

[3] Chromik, Š., Vincenc Oboňa, J., Kostič, I.: *Preparing of the submicrometer structures by patterning of the superconducting thin films with using a C60 resist mask*, No. 5016-2006

[2] This information is required only from the Organisations of the Section 2 of the Slovak Academy of Sciences.

[3] This information is required only from the Organisations of the Section 3 of the Slovak Academy of Sciences.

[9] 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	2002			2003			2004			2005			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
Web of Science	306	5.8	14.2	369	7.1	16.4	314	5.9	13.8	349	6.1	14.7	1348	334.5	6.2	59.5
SCOPUS	18	0.3	0.8	16	0.3	0.7	30	0.6	1.3	30	0.5	1.3	94	23.5	0.4	4.1
(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
in monographs, conf. proceedings and other publications abroad	20	0.4	0.9	20	0.4	0.9	35	0.7	1.5	6	0.1	0.3	81	20.3	0.4	3.6
in monographs, conf. proceedings and other publications in Slovakia	1	0.0	0.0	1	0.0	0.0	1	0.0	0.0	8	0.1	0.3	11	2.8	0.1	0.5

i. List of 10 top-cited publications and number of their citations in the assessment period

[1] 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. – **117**

[2] Hlinka, J., Gregora, I., Pokorný, J., **Plecenik**, **A**., Kúš, P., **Satrapinsky, L**., and **Beňačka**, **Š**.: Phonons in MgB_2 by polarized Raman scattering on single crystals, Phys. Rev. B **64** (2001) 140503-1-140503-4. - **38**

[3] **Gömöry**, **F**.:Characterization of high-temperature superconductors by AC susceptibility measurement, Topical Review, Superconductor Sci and Technology **10** (1997) 523. - **35**

[4] **Plecenik**, **A**., **Satrapinsky**, **L**., Kúš, P., **Gaži**, **Š**., **Beňačka**, **Š**., **Vávra**, **I**., and Kostič, I.: MgB_2 superconductor thin films on Si and Al_2O_3 substrates, Physica C **363** (2001) 224-230, also Cond.Mat. 0105612. - **26**

[5] Dobročka, E. and **Osvald**, **J**.: Influence of barrier height distribution on the parameters of Schottky diodes, Applied Phys. Lett. **65** (1994) 575. - **20**

[6] Pignard, S., Vincent, H., Senateur, P., **Fröhlich**, **K**., and **Šouc**, **J**.: Effect of crystallinity on the magnetoresistive properties of $La_{0,8}MnO_{3-\delta}$ thin films grown by chemical vapor deposition, Applied Phys. Letters **73** (1998) 999. - **18**

[7] **Plecenik, A., Beňačka, Š**., Kúš, P., and Grajcar, M.: Superconducting gap parameters of MgB_2 obtained on MgB_2/Ag and MgB_2/In junctions, Physica C 368 (2002) 251-254, also Cond.Mat. 0104038. - **18**

[8] **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. – **17**

[9] **Polák**, **M**., **Hlásnik**, **I**. and **Krempaský**, **L**.: Voltage-current characteristics of NbTi and Nb_3Sn superconductors in the flux creep region, Cryogenics **13** (1973) 702. – **16**

[10] Hotovy, I., **Huran**, **J**., Sicialiano, P., Capone, S., Spiess, L., and Rehacek, V.: The influence of preparation parameters on NiO thin film properties for gas-sensing application, Sensors & Actuators B **78** (2001) 126-132. - **13**

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

[1] Ing. Pavol Kováč, DrSc. - 202

[2] Ing. Fedor Gömöry, DrSc. – 155

[3] Ing. Milan Polák, DrSc. - 101

[4] Ing. Karol Fröhlich, DrSc. – 93

[5] Ing. Ivo Vávra, CSc. - 92

iii. 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). Collective membership in the international research organisations, in particular within the European Research Area

[1] Centre of Excellence: Applied Superconductivity Training and Research Advanced Centre – ASTRA, 5th FP project

[2] Quality monitoring of Superconductors for the production of Efficient, Compact and reliable Energy Transmission Systems, Q-SECRET, 5th FP project

[3] Metal OxideMultilayers obtained by Cost-Effective New CVD Technologies for Magnetoelectronic Microsystems and Nanotechnologies – MULTIMETOX, 5th FP project

[4] Superconducting European Network SCENET-2, 5th FP project

[5] Integration of very high-k dielectrics with silicon CMOS technology – INVEST, 5th FP project

[6] New gallium phosphide grown by vertical gradient freeze method for light emitting Diodes, VGF, 5th FP project

[7] EURATOM: Measurement of the current distribution inside superconducting cable - supply and installation of Hall probe measuring system and joining of multifilamentary Nb_3Sn strands, 5th FP project

[8] Superconducting coated conductor cable – SUPER3C, 6th FP project

[9] Nano- and micro-scale engineering of higher-performance MgB_2 composite superconductors for macro-scale applications – HIPERMAG, 6th FP project

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

[11] Nano-Engineering Superconductors for Power Applications – NESPA, 6th FP project

[12] Microwave Monolithic Integrated Transmitted Power Sensors and Their Industrial and Metrological Applications, NATO SfP

[13] High temperature superconducting model transformers using BSCCO and YBCO tapes, NATO SfP

[14] Transverse resistivity of YBCO coated conductors for AC use, AFOSR

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

[1] ASDAM'04 - Advanced Semiconductor Devices and Microsystems, Smolenice, October 17-21, 2004

[2] Workshop in the frame of the ASTRA project “Low T_c and high T_c superconductor in power applications: contactless testing”.

[3] Workshop in the frame of the ASTRA project "Superconductivity in European power applications"

[4] ECONET Meeting, Bratislava (Egide, Paris)

[5] 14th International Workshop on Heterostructure Technology, October 2-5, 2005

[6] Workshop on Weak Superconductivity, September 16-19, 2005, Bratislava

[7] 6th Autumn School on X-ray Scattering and Thin Layers, September 18-20, 2005, Smolenice (MFF KU, Praha)

[8] ASDAM’06, October 16-18, 2006, Smolenice (FEI STU)

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] OSVALD, Jozef (ed.) - HAŠČÍK, Štefan (ed.). *ASDAM 2004 : conference proceeding of the Fifth International Conference on Advanced Semiconductor Devices and Microsystems. Smolenice Castle, Slovakia October 17-21, 2004*. Piscataway: IEEE, 2004. ISBN 0-7803-8535-7.

[2] Workshop in the frame of the ASTRA project “Low Tc and high Tc superconductor in power applications: contactless testing” – CD-rom

[3] Workshop in the frame of the ASTRA project "Superconductivity in European power applications" – CD-rom

- **National position of the Organisation**

i. List of selected most important national projects (Centres of Excellence, National Reference Laboratories, Agency for the Promotion of Research and Development (APVV/APVT), National Research Programmes, Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA), and others)

[1] Centre of Excellence SAS No. 01/2005 Centre of Advanced Devices in Electronic and Electrical Engineering (CENG)

[2] ESF & Ministry of Education SR No.13120200043 Educational Centre for Information Technology and Power Engineering (VCITE)

[3] Slovak Gov. Order No. SO 51/03R 06 00/03R 06 02 New materials and devices in sub-micrometer technology, Part 02, application of new structures and devices based on sub-micrometer thin films technologies

[4] Slovak Gov. Order No. 95017/78 Millimetre waves devices (94 GHz)

[5] Investigation of high temperature superconducting thin film detectors for superconducting quantum interfence devices (SQUID), APVT

[6] Synthesis of polycrystalline indium phosphide and its characterization, APVT

[7] Electromagnetic properties of superconducting composite conductors, APVT

[8] Submicron vector Hall microscope, APVT

[9] Composite superconductors for cryogen-free devices, APVT

[10] Epitaxial structures for high-brightness LEDs prepared on GaP substrates, APVT

[11] Integrated MEMS senzors based on magnetoresistive thin films, APVT

[12] Thin oxide films for advanced MOS structures, APVT

[13] Superconducting wires in the conditions of power electric devices, APVV

[14] Pinning in the new types of superconducting wires, APVV

[15] Monolitically integrated circuits based on GaAs (GaN) with passive superconducting filters for millimeter wave band, APVV

[16] The study of electric current distribution processes in superconducting conductors at DC and AC applications, APVV

[17] The dynamics of current distribution in 2nd generation superconductors for AC applications, APVV

[18] Preparation of "active" tips for probe microscopy by MOCVD, APVV

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

[1] “Nanoved 2003”, 28. – 29. 1. 2003, Bratislava

[2] “Nanoved 2004”, 13-14 Sept., 2004, Košice (ÚMV SAV)

[3] Seminar CENG, 25-26 Sept., 2006, Smolenice

iii. List of national journals published by the Organisation

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

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

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

[1] Chromik, Š.: The activities of Department of Cryoelectronics at the IEE SAS, Bratislava. In: 4th Int. Conf. on olid State Surfaces and Interfaces. Smolenice 2004.

[2] Fröhlich, K., Lupták, R., Ťapajna, M., Hušeková, K., Weber, U., Baumann, P.K., and Lindner, J.: Fixed oxide charge in Ru-based chemical vapour deposited high-κ gate stacks. In: NATO Advanced Research Workshop Defects in Advanced High-K Dielectric Nano-Electronic Semicond. Devices. St. Peterburg 2005. Defects in Advanced High-K Dielectric Nano-Electronic Semicond. Devices. Ed. E. Gusev. Amsterdam: Springer 2006. P. 277-287.

[3] Gömöry, F., Šouc, J., Vojenčiak, M., Seiler, E., Klinčok, B., Ceballos, J., Pardo, E., Sanchez, A., Navau, C., Farinon, S., and Fabbricatore, P.: Predicting AC loss in practical superconductors. In: EUCAS 2005 – European Conference on Applied Superconductivity. Viedeň 2005.

[4] Takács, S.: AC losses in HTS cable. In: 15th Inter. Toki Conf. Fusion and Advanced Technol. Toki 2005.

[5] Cambel, V., Martaus, J., Šoltýs, J., Kúdela, R., and Gregušová, D.: AFM nanooxidation process – technology perspective for mesoscopic structures. In: Int. Conf. On Nanopatterned and Self-Assembled systems, NANOSEA. Aix-en-Provence 2006.

[6] Dubecký, F.: Key aspects of material and technology in fabrication of GaAs and InP-based radiation detectors. In: Int. Workshop On Crystal growth & Characterization of Advanced Materials. Chennai (India), Anna Univ. 2006.

[7] Frőhlich, K., Lupták, R., Dobročka, E., Hušeková, K., Čičo, K., Rosová, A., Lukosius, M., Abrutis, A., Písečný, P., and Espinos, J.P.: Characterization of rare earth oxides based MOSFET gate stacks prepared by metal-organic chemical vapour deposition. In: E-MRS Spring Meeting 2006 – Symp. L: Characterization of high-K dielectric materials. Nice 2006.

[8] Kordoš, P.: GaN-based electronics for advanced information electronics. In: 3rd Inter. Symposium n Ubiquitous Knowledge Network Environment. Sapporo 2006.

[9] Lobotka, P.: Correlation between electrotransport and structure of a nanocomposite. ESF Exploratory Workshop – Carbon-Based Nanostructured Composite Films. Gdansk 2006.

[10] Chromik, Š.: Hg-based cuprate superconducting cryoelectronic structures. In: 5th Int. Conf. on Solid State Surfaces and Interfaces. Smolenice 2006.

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

[1] Ing. Milan Polák, DrSc. – Inter. Organizing Committee 18th Inter. Conf. on Magnet Technology, Morioka, Japan, Oct. 20-24, 2003

[2] Ing. Daniel Machajdík, CSc. - Inter. Scientific Committee Inter. Conf. Ion Implantation and Other Applications of Ions and Electrons, Kazimierz Dolny, June 14 – 17, 2004

[3] Ing. František Dubecký, CSc. – Inter. Organizing Committee SIMC-XIII-2004, Beijing,

[4] RNDr. Dušan Korytár, CSc. - X-TOP 2004, Řež pri Prahe, Sept. 7-10, 2004

[5] Ing. Fedor Gömöry, DrSc. - Scientific Program Committee 19th Inter. Conf. on Magnet Technology, Janov, Sept. 18-23, 2005

[6] Ing. Milan Polák, DrSc. – Inter. Organizing Committee 19th Inter. Conf. on Magnet Technology, Janov, Sept. 18-23, 2005

[7] Ing. Fedor Gömöry, DrSc. - Inter. Advisory Committee 7th European Conf. on Applied Supercond. EUCAS, Vienna, Sept. 11-15, 2005

[8] doc. RNDr. S. Takács, DrSc. - Scientific Program Committee 15th Inter. Toki Conf. Fusion and Advanced Technol., Toki, Dec. 6-9, 2005.

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

[1] Ing. Milan Polák, DrSc., member of Financial board of CERN, Geneva, Švajčiarsko

[2] Doc. Ing. Jozef Novák, DrSc., member of Scientific Commission URSI (Union Radio-Scientifique Internationale - Scientific commission D-Electronics and photonics)

[3] Doc. Ing. Jozef Novák, DrSc., member of National Board URSI (Union Radio-Scientifique Internationale)

[4] Ing. Milan Polák, DrSc., member of Slovak Board for Cooperation with CERN

[5] RNDr. Štefan Beňačka, CSc., member of National Board of IUPAP

[6] Ing. Daniel Machajdík, CSc., member of National Board for Cooperation with JINR Dubna

iv. List of international scientific awards and distinctions

[1] In 2003 the Institute received project "Centrum of Excellence" of 5th Framework Programme: ASTRA (Applied Superconductivity Training and Research Advanced Centre).

- **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

[1] Ing. Ivo Vávra, CSc. – Nanoved 2004, 13.-14. 9. 2004, Košice

[2] Ing. Peter Lobotka, CSc. – Nanoved 2004, 13.-14. 9. 2004, Košice

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

[1] Ing. Ivo Vávra, CSc., member of the board of Československa mikroskopicka spoločnosť

[2] Ing. František Dubecký, CSc., member of the board of OS Polovodiče pri JČ-SMF

[3] RNDr. Š. Beňačka, CSc., member of the board of Slovenskej fyzikálnej spoločnosti

[4] Doc. RNDr. Edmund Dobročka, CSc., member of the board of Jednota slovenských matematikov a fyzikov pri SAV, podpredseda JSMF

[5] Doc. Ing. Jozef Novák, DrSc., Scientific council FEI STU

[6] Doc. Ing. Jozef Novák, DrSc. Scientific council Fakulty of Mechatronics TNUAD

[7] Doc. RNDr. Silvester Takács, DrSc., Scientific council MFF UK

[8] Ing. Karol Fröhlich, DrSc. Scientific council Fakulty of Mechatronics TNUAD

[9] RNDr. Martin Moško, CSc. , member of editorial board of Acta Physica Slovaca

[10] Mgr. A. Gendiar, PhD executive editor of Acta Physica Slovaca

[11] Doc. RNDr. S. Takács DrSc. member of editorial board of Acta Phys. Univ. Comen.

[12] Doc. Ing. J. Novák, DrSc, member of editorial board of Journal of Electrical Engineering

[13] Doc. Ing. P. Kordoš, DrSc, member of editorial board of Journal of Electrical Engineering

[14] Ing. J. Novák, DrSc., member of editorial board of Metrológia a skúšobníctvo

iv. List of national awards and distinctions

[1] Doc. RNDr. S. Takács, DrSc., Golden Medal SAS

[2] In 2004 the Institute was awarded by the Slovak Ministry of Education as „Prestigious organisation of research in Slovakia"

[3] "Zlatá Incheba"- for digital X-ray scanner presented at the international trade fair Incheba Bratislava 2004

[4] RNDr. Š. Beňačka, CSc., medal of Slovak Committee of Physics

[5] Mgr.B. Zaťko, PhD., 2. prize in competition of youn reseach scientists.

[6] Medal of the dean of Faculty of Electrotechnics and Informatics of Slovak University of Technology on the occasion of foundation of Institute of Electrical Engineering

[7] Golden medal of Faculty of Mathematics, Physics and Informatics of Comenius University on the occasion of foundation of Institute of Electrical Engineering.

[8] Since 2005 Centre of Excellence SAS, Centre of Advanced Devices in Electronic and Electrical Engineering - CENG

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

During the past period the Institute was awarded two importants international and national projects: Applied Superconductivity Training and Research Advanced Centre – ASTRA, and Centre of Advanced Devices in Electronic and Electrical Engineering – CENG. Acquisition of the projects we understand as an appreciation of quality of scientific research performed by the Institute.

4. Project structure, research grants and other funding resources

- **International projects and funding**

i. List of major projects within the European Research Area – 5th and 6th Framework Programme of the EU, European Science Foundation, NATO, COST, INTAS, CERN, etc. (here and in items below please specify: type of project, title, grant number, duration, funding, responsible person in the Organisation and his/her status in the project, e.g. coordinator, principal investigator, investigator)

European Research Area – 5th Framework Programme of the EU

[1] Applied Superconductivity Training and Research Advanced Centre - ASTRA
Responsible person in IEE SAS: Ing. F. Gömöry, DrSc., coordinator
01/2003 – 12/2005
ENK6-CT-2002-80658
Type of project: Acompanying measures
Total budget for IEE SAS: 200 000 €

[2] Quality monitoring of Superconductors for the production of Efficient, Compact and reliable Energy Transmission Systems, Q-SECRET
Responsible person in IEE SAS: Ing. F. Gömöry, DrSc., principal investigator
07/2000 – 06/2003
G3RD-CT-2000-00239
Total budget for IEE SAS: 200 000 €

[3] Metal Oxide Multilayers obtained by Cost-Effective New CVD Technologies for Magnetoelectronic Microsystems and Nanotechnologies - MULTIMETOX
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
01/2000 – 3/2003
G5RT-CT-2000-05001
Type of project: Thematic Network
Total budget for IEE SAS: 60 000 €

[4] Superconducting European Network SCENET-2
Responsible person in IEE SAS: Ing. F. Gömöry, DrSc., principal investigator
1/2002-12/2005
G5RT-CT-2002-05077
Total budget for IEE SAS: 3 200 €

[5] Integration of very high-k dielectrics with silicon CMOS technology - INVEST
Responsible person in IEE SAS: Ing. Karol Fröhlich, DrSc., principal investigator
IST-2001-39094
2001 - 2005
Type of project: RTD

Total budget for IEE SAS: 134 000 €

[6] New gallium phosphide grown by vertical gradient freeze method for light emitting Diodes, VGF
Responsible person in IEE SAS: doc. Ing. J. Novák, DrSc., principal investigator
12/2001-5/2004
IST-2001-32793
Total budget for IEE SAS: 120 000 €

[7] Measurement of the current distribution inside superconducting cable - supply and installation of Hall probe measuring system and joining of multifilamentary Nb_3Sn strands
Responsible person in IEE SAS: Ing. M. Polák, DrSc., principal investigator
06/2003 - 06/2004
FU 06 – CT - 2003-00041
Total budget for IEE SAS: 94 000 €

European Research Area – 6th Framework Programme of the EU

[8] Superconducting coated conductor cable – SUPER3C
Responsible person in IEE SAS: Ing. F. Gömöry DrSc., principal investigator
06/2004 – 05/2008
SES6-CT-2004-502615
Type of project: STREP
Total budget for IEE SAS: 190 000 €

[9] Advanced Semiconductor Devices and Microsystems–ASDAM '04
Responsible person in IEE SAS: Ing. J. Osvald, DrSc., coordinator
04/2004 – 03/2005
NMP4-CT-2004-003366
Type of project: Conference
Total budget for IEE SAS: 20 000 €

[10] Nano- and micro-scale engineering of higher-performance MgB_2 composite superconductors for macro-scale applications, HIPERMAG
Responsible person in IEE SAS: Ing. P. Kováč DrSc., principal investigator
09/2004 – 08/2008
NMP3-CT-2004-505724
Type of project: STREP
Total budget for IEE SAS: 164 700 €

[11] AC losses measurements on high temperature superconductors
Responsible person in IEE SAS: Ing. F. Gömöry DrSc., coordinator
12/2005 – 01/2008
FU06-CT-2005-00047 No. 801465
Type of project: CSA
Total budget for IEE SAS: 40 000 €

[12] InAlN/(In)GaN Heterostructure Technology for Ultra-high Power Microwave Transistor, ULTRAGAN
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
9/2005 – 8/2008
006903

Type of project: STREP
Total budget for IEE SAS: 100 000 €

[13] Conductance of disordered mesoscopic conductor obtained from many-body calculation of electronic structure, CONDIMEC
Responsible person in IEE SAS: RNDr. M. Moško, CSc., principal investigator
01/2005 – 12/2005
MERG-CT-2004-006339
Total budget for IEE SAS: 40 000 €

[14] Nano-Engineering Superconductors for Power Applications - NESPA
Responsible person in IEE SAS: Ing. F. Gömöry, DrSc., principal investigator
10/2006 – 11/2010
MRTN-CT-2006-035619
Type of project: Training Network
Total budget for IEE SAS: 400 000 €

European Science Foundation

[15] Thin films for novel oxide devices (THIOX)
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
01/2003 - 12/2007
Type of project: Network

[16] Arrays of Quantum Dots and Josephson Junctions (AQDJJ))
Responsible person in IEE SAS: RNDr. Š. Beňačka, CSc., principal investigator
6/2004 – 6/2009
Type of project: Network
Total budget for IEE SAS: 6 000 €

NATO

[17] AC losses in Bi-based multifilamentary superconducting tapes
Responsible person in IEE SAS: Ing. F. Gömöry, DrSc., principal investigator
4/2001-3/2003
NATO PST.CLG.97717
Total budget for IEE SAS: 6 000 €

[18] Electromagnetic properties of superconducting composites
Responsible person in IEE SAS: Ing. F. Gömöry, DrSc., principal investigator
10/2003 – 09/2005
NATO PST.CLG.980001
Total budget for IEE SAS: 8 000 €

[19] Microwave Monolithic Integrated Transmitted Power Sensors and Their Industrial and Metrological Applications
Responsible person in IEE SAS: Ing. T. Lalinský, CSc., principal investigator
3.12.1999 – 2.12.2003
NATO SfP-974172
Total budget for IEE SAS: 270 200 €

[20] High temperature superconducting model transformers using BSCCO and YBCO tapes
Responsible person in IEE SAS: Ing. M. Polák, DrSc., principal investigator
1.1.2000 – 31.12.2003
NATO SfP-974124
Total budget for IEE SAS: 150 000 €

COST

[21] Growth of barriers, electrodes and functional oxide layers for integration in microelectronics
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
3/2001-12/2006
COST 528

[22] One-dimensional electron transport in V-groove GaAs quantum wires: Measurement and simulations for a broad temperature range
Responsible person in IEE SAS: RNDr. M. Moško, CSc., principal investigator
4/1999-3/2003
COST P5

[23] X-ray and neutron optics
Responsible person in IEE SAS: RNDr. Dušan Korytár, CSc., principal investigator
1/2002 – 3/2006
COST P7 (COST 844)

[24] Nanostrured materials
Responsible person in IEE SAS: Ing. P. Lobotka, CSc., principal investigator
3/2001-12/2004
COST 523

[25] Monolithic X-ray optics with multiple successive diffraction
Responsible person in IEE SAS: RNDr. D. Korytár, CSc., principal investigator
01/2002 - 03/2006
COST 57(COST 844)

INTAS

[26] Metal-oxide thin film heterostructures on tilted-axes substrates
Responsible person in IEE SAS: RNDr. Štefan Beňačka, CSc., principal investigator
7.2002-6.2005
INTAS-01-0249
Total budget for IEE SAS: 13 000 €

ii. List of other international projects incl. funding

European Office of Aerospace Research and Development – EOARD

[1] AC loss minimization in high temperature superconductors
Responsible person in IEE SAS: Ing. Milan Polák, DrSc., principal investigator

06/2002 - 09/2003
F61775-02-WE4065
Total budget for IEE SAS: $20 000

[2] Transverse resistivity of YBCO coated conductors for AC use
Responsible person in IEE SAS: Ing. M. Polák, DrSc., principal investigator
11/2003 - 10/2005
FA 8655-03-1-3082
Total budget for IEE SAS: $64 000

[3] Superconducting coils for AC currents using YBCO coated conductors
Responsible person in IEE SAS: Ing. Milan Polák, DrSc., principal investigator
09/2005 - 09/2006
FA8655-05-1-3062
Total budget for IEE SAS: $20 000

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

[1] Preparation and characterization of GaN based heterostructures and devices
Responsible person in IEE SAS: doc. Ing. J. Novák, DrSc., principal investigator
06/2001 - 12/2004
SLA 005-01
Partner: ISG Jülich, Germany

[2] Technology and properties of GaN based heterostructures and devices
Responsible person in IEE SAS: doc. Ing. J. Novák, DrSc., principal investigator
2005 - 2006
Partner: ISG Jülich, Germany

[3] Preparation and characterization of semiconductor structures and devices for radiation detection and X-ray optics
Responsible person in IEE SAS: Ing. F. Dubecký, CSc., principal investigator
01/2001 - 12/2005
02
Partner: IMEM CNR Parma, Italy

[4] Applications of semiconductor single crystals for X-ray optics, monolithic X-ray detectors and high efficiency solar cells
Responsible person in IEE SAS: Ing. F. Dubecký, CSc., principal investigator
01/2004 - 12/2006
02
Partner: CNR Parma, Italy

[5] Development of directly converting X-ray detectors
Responsible person in IEE SAS: Ing. F. Dubecký, CSc., principal investigator
01/2001 - 12/2006
02
Partner: DAAD, Germany

[6] Study of nanogranular superconductors
Responsible person in IEE SAS: Ing. P. Lobotka, CSc., principal investigator
01/2004 - 12/2005
02

Partner: JINR Dubna, Russian

[7] Technology and properties of GaN-based MOS HFET transistors
Responsible person in IEE SAS: Ing. J. Kuzmík, CSc., principal investigator
2004 - 2005
Partner: FORTH, Crete, Greece

[8] Bi-2223/Ag superconductors for coil windings
Responsible person in IEE SAS: Ing. P. Kováč, DrSc., principal investigator
10/2000 - 09/2003
GZ45.481/2-VIII/B/8a/2000
Partner: Ministry of education, Austria

[9] AC losses in AC fields in high temperature superconductors
Responsible person in IEE SAS: Ing. F. Gömöry, DrSc., principal investigator
04/2001 - 03/2003
GZ45.481/2-VIII/B/8a/2000
Partner: British Royal Society, UK

[10] Theoretical and experimental study of semiconductor quantum structures
Responsible person in IEE SAS: Ing. J. Osvald, DrSc., principal investigator
01/2001 - 12/2003
GZ45.481/2-VIII/B/8a/2000
Partner: MAF Budapest, Hungary

[11] Thin oxide films preparation and properties
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
2004 - 2005
Partner: ICM Centro de Investigaciones Cientificas Sevilla, Spain

[12] Quantum transport in mesoscopic conductors: many-body theory and experimental studies
Responsible person in IEE SAS: RNDr. M. Moško, CSc., principal investigator
2004 - 2005
Partner: ISG Forschungszentrum Jülich, Germany

[13] Thin films and superlattices of functional oxides – ECO NET
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
2004 - 2006
Partner: Laboratoire des Materiaux et du Genie physique, INPG, Grenoble, France

[14] Thin film nanocomposites containing fulleren-like structures
Responsible person in IEE SAS: Ing. I. Vávra, CSc., principal investigator
2004 - 2006
Partner: MAF Budapest, Hungary

[15] Study of the transport properties of superconducting nanograins in dielectric matrix
Responsible person in IEE SAS: Ing. P. Lobotka, CSc., principal investigator
2004 - 2007
Partner: CNR Padova, Italy

[16] Structural, electrical and optical characterization of advanced semiconducting and superconducting oxides and layered structures

Responsible person in IEE SAS: doc. Ing. J. Novák, DrSc., principal investigator
2004 - 2006
Partner: ICM Centro de Investigaciones Cientificas Sevilla, Spain

[17] High Tc Josephson junctions – fabrication methods and properties
Responsible person in IEE SAS: Ing. Š. Chromik, DrSc., principal investigator
2004 - 2006
Partner: PAV Warsaw, Poland

[18] Measurement of X-ray emission from tokamak plasma (MAST) by the use of matrix semiconductor detectors
Responsible person in IEE SAS: Ing. F. Dubecký, CSc., principal investigator
1/2005 – 12/2006
Type of project: EURATOM
Partner: PAV, Warsaw, Poland

[19] Sandwich structures based on cuprates, dielectrics and manganites: physical properties and application possibilities
Responsible person in IEE SAS: Ing. Š. Chromik, DrSc., principal investigator
2004 - 2006
Partner: BAV Sofia, Bulgary

[20] Electromagnetic properties of superconducting composites
Responsible person in IEE SAS: Ing. P. Kováč, DrSc., principal investigator
2003 - 2005
Partner: INFN Genoa, Italy

[21] Thin oxide films for nanoelectronic applications
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
2006 - 2007
Partner: Cientificas “Isla de la Cartuja“ Sevilla, Spain

[22] Investigation of dielectric properties and leakage currents in Ru/high-k (Ta_2O_5, (Hf, Ti)-doped Ta_2O_5) capacitors for advanced sub-90nm technology node applications
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
2006 - 2007
Partner: Inst. of Solid State Physics, Sofia, Bulgary

[23] Advanced nanostructures and materials for application in information and energy technologies. Structural aspects
Responsible person in IEE SAS:., principal investigator
2006 - 2007
Partner: ICMAB Barcelona, Spain

- **National projects and funding**

i. List of projects supported by the Agency for the Promotion of Research and Development (APVV/APVT), National Research Programmes, and their funding Centre of Excellence SAS

[1] Centre of electronic and electrotechnique advanced devices - CENG
Responsible person: Ing. F. Gömöry, DrSc., principal investigator
2005 - 2008
No. 01/2005
Total budget: 1 050 000 Sk (r. 2005-2006)

Slovak Republic State order

[2] New materials and devices in sub-micrometer technology. Part 1, development of submicrometer technologies, Part 02, application of new structures and devices based on sub-micrometer thin films technologies
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
2003 - 2005
No. SO 51/03R 06 00/03R 06 02
Total budget for IEE SAS: 8 400 000 Sk

EC - ESF & Ministry of Education SR

[3] Educational Centre for Information Technology and Power Engineering (VCITE)
Responsible person: RNDr. V. Cambel, CSc., principal investigator
01/2005 – 12/2008
No. 13120200043
Total budget: 6 586 800 Sk

[4] Vybudovanie výskumno-vývojovej a inovačnej siete pre oblasť materiálov a technológií ich spájania (MatNet)
Responsible person in IEE SAS: Ing. K. Fröhlich, DrSc., principal investigator
04/2006 – 05/2009
No. 13120200076
Total budget for IEE SAS: 524 000 Sk

APVT

[1] Investigation of high temperature superconducting thin film detectors for superconducting quantum interfence devices (SQUID)
Responsible person: RNDr. Š. Beňačka, CSc., principal investigator
2002 - 2005
No. 51-022702
Total budget: 3 926 000 Sk

[2] Synthesis of polycrystalline indium phosphide and its characterization
Responsible person: doc. Ing. J. Novák, DrSc., principal investigator
2002 - 2004
No. 99-018602
Total budget: 388 500 Sk

[3] Electromagnetic properties of superconducting composite conductors
Responsible person: Ing. F. Gömöry, DrSc., principal investigator
2002 - 2005
No. 51-012902
Total budget: 2 325 000 Sk

[4] Submicron vector Hall microscope
Responsible person: RNDr. V. Cambel, CSc., principal investigator
2002 - 2005

No. 26-020902
Total budget: 1 851 000 Sk

[5] Composite superconductors for cryogen-free devices
Responsible person: Ing. P. Kováč, DrSc., principal investigator
2004 - 2006
No. 51-029902
Total budget: 2 400 000 Sk

[6] Epitaxial structures for high-brightness LEDs prepared on GaP substrates
Responsible person: doc. Ing. J. Novák, DrSc., principal investigator
2004 - 2006
No. 51-050602
Total budget: 2 876 000 Sk

[7] Integrated MEMS senzors based on magnetoresistive thin films
Responsible person: Ing. P. Lobotka, CSc., principal investigator
2004 - 2006
No. 51-032902
Total budget: 4 536 000 Sk

[8] Thin oxide films for advanced MOS structures
Responsible person: Ing. K. Fröhlich, DrSc., principal investigator
2005 - 2007
No. 51-017004
Total budget: 3 850 000 Sk

[9] Superconducting wires in the conditions of power electric devices
Responsible person: Ing. F. Gömöry, DrSc., principal investigator
2006 - 2008
No. 51-045605
Total budget: 2 560 000 Sk

[10] Pinning in the new types of superconducting wires
Responsible person: Ing. F. Gömöry, DrSc., principal investigator
2006 - 2008
LPP-0815-06
Total budget: 1 198 000 Sk

[11] Monolitically integrated circuits based on GaAs (GaN) with passive superconducting filters for millimeter wave band
Responsible person: Ing. Š. Chromik, DrSc., principal investigator
2006 - 2008
51-040605
Total budget: 4 633 000 Sk

[12] The study of electric current distribution processes in superconducting conductors at DC and AC applications
Responsible person: RNDr. P. Ušák, PhD., principal investigator
2006 - 2008
No. 51-002305
Total budget: 3 094 000 Sk

[13] The dynamics of current distribution in 2nd generation superconductors for AC applications

Responsible person: RNDr. P. Ušák, PhD., principal investigator
2006 - 2008
No. LPP-0245-06
Total budget: 1 200 000 Sk

[14] Preparation of "active" tips for probe microscopy by MOCVD
Responsible person: RNDr. V. Cambel, CSc., principal investigator
2006 - 2008
No. 51-045705
Total budget: 12 188 000 Sk

[15] Strongly correlated and disordered electronic systems
Responsible person in IEE SAS: RNDr. M. Moško, CSc., principal investigator
2002 - 2005
No. 20-021602
Total budget for IEE SAS: 208 000 Sk

[16] Preparation of high quality GaMnN thin layers for spintronics
Responsible person in IEE SAS: doc. Ing. J. Novák, DrSc., principal investigator
2005 - 2007
No. 20-026104
Total budget for IEE SAS: 630 000 Sk

Other national projects with funding

[17] Monolithically integrated HEMT-SAW chemical sensors based AlGaN piezoelectric material system
Responsible person: Ing. T. Lalinský, CSc., principal investigator
2006 - 2007
Slovak-French project SK-FR-01906
Total budget: 80 000 Sk

[18] Electro-thermal converter monolithically integrated with HEMT-SAW chemical sensors
Responsible person: Ing. T. Lalinský, CSc., principal investigator
2006 - 2007
SK-95/CZ-80
Total budget for IEE SAS: 35 000 Sk

[19] Superconductors for future technologies
Responsible person in IEE SAS: RNDr. Š. Haščík, principal investigator
2005 - 2007
No. 51-016604
Total budget for IEE SAS: 540 000 Sk

[20] Gas-sensitive microsystem based on GaAs micromechanical structures
Responsible person in IEE SAS: Ing. T. Lalinský, CSc., principal investigator
2004 - 2007
No. 1115/2004
Total budget for IEE SAS: 120 000 Sk

[21] Monolithically integrated microsystem for gas detection based on GaAs micromechanical structures

Responsible person in IEE SAS: Ing. T. Lalinský, CSc., principal investigator
2005 - 2007
No. 20-021004
Total budget for IEE SAS: 900 000 Sk

[22] Coherence, decoherence and disorder in metallic and superconducting systems
Responsible person in IEE SAS: RNDr. M. Moško, CSc., principal investigator
2006 - 2009
No. 51-003505
Total budget for IEE SAS: 333 000 Sk

[23] A new generation digital radiology system kit
Responsible person in IEE SAS: Ing. F. Dubecký, CSc., principal investigator
2005 - 2007
No. 99-PO6305
Total budget for IEE SAS: 1 640 000Sk

Ministry of Industry SR

[5] Modular imaging X-ray system utilizing radiation detectors based on GaAs semiconductor compound
Responsible person in IEE SAS: Ing. F. Dubecký, CSc., principal investigator
04/2001 – 03/2004
No. 99026II02I
Total budget for IEE SAS: 865 000 Sk

i. 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	2003	2004	2005	2006
number	9	9	11	11
funding (millions of SKK)	1.385	1.622	1.984	2.166

- **Summary of funding from external resources**

External resources	2003	2004	2005	2006	total	average
external resources (millions of SKK)	31.652	26.534	34.303	33.943	126.432	31.608
external resources transfered to coooperating research organisations (millions of SKK)	3.104	3.556	3.513	1.857	12.030	3.008
ratio between external resources and total salary budget	1.468	1.178	1.510	1.425	5.580	1.395
overall expenditures (millions of SKK)	63.407	63.490	70.464	70.095	267.456	66.864

Supplementary information and/or comments on research projects and funding resources

We appreciate that external funding during the period 2003 – 2006 achieved nearly 50 % of the overall expenditure. It should be noted, that great majority of external funding comes from research projects either from European Commission or from national agencies (VEGA, APVV).

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

11-22-9 “Physics of condensed matter and acoustics”
26-02-9 “Theoretical electrotechnics”
26-13-9 “Electronics”
26-35-9 “Electrotechnology and materials”

List of programmes accredited since 2004

4.1.3 "Physics of condensed matter and acoustics"
5.2.13 "Microelectronics"
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	31/12/2003			31/12/2004			31/12/2005			31/12/2006		
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
internal	15	2		11	2		12	3		12	6	
external	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.

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

Mgr. Eugen Seiler, PhD.
Ing. Eduard Demenčík, PhD.
Ing. Ján Šoltýs, PhD.

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

Teaching	2003	2004	2005	2006
lectures (hours/year)	28	5	163	288
practicum courses (hours/year)	0	0	0	24
supervised diploma works (in total)	8	9	13	8
members in PhD committees (in total)	9	7	14	10
members in DrSc. committees (in total)	2	6	4	6
members in university/faculty councils (in total)	3	2	2	2
members in habilitation/inauguration committees (in total)				

v. List of published university textbooks

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vi. Number of published academic course books

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

In 2005 the Institute was awarded by the project Centre of Excellence Slovak Academy of Science - Centre of Advanced Devices in Electronic and Electrical Engineering, CENG in cooperation with Faculty of Electrical Engineering and Information Technology of Slovak University of Technology in Bratislava and with the Faculty of Mathematics, Physics and Informatics of Comenius University in Bratislava.

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

In 2004 the Institute was succesfully accredited in 3 new PhD study programs. In PhD study the Institute closely cooperates with Faculty of Electrical Engineering and Information Technology of Slovak University of Technology in Bratislava and with the Faculty of Mathematics, Physics and Informatics of Comenius University in Bratislava. During the assessed period 13 students accomplished their PhD study in the Institute. Some of them expressed interest to continue their carrier in the research.

6. Direct output to the society
(applications of results, popularisation and outreach activities)

i. List of the most important results of applied research projects

[1] The special modular power optocoupplers were designed and developed in cooperation with company NES Nová Dubnica as an industrial partner. These power optocoupplers are targeted to serve as an isolated power supply for small special electronic systems (communications units, safety systems or starting units). Basic modul is designed for output power of 100 mW and isolation voltage up to 22 kV. To allow the direct loading from high voltage sources the light emitting devices on the input side are in serial connection. Income of the project was 500 000 Sk.

[2] Portable digital X-ray scanner utilizing monolithic GaAs X-ray sensors.

Authors: F. Dubecký, B. Zaťko, P. Boháček

The result presents successful realization of the portable digital modular X-ray scanner based on application of monolithic X-ray GaAs line detectors. This is a unique radiographic equipment where X-ray imaging is realised in quantum mode („single photon counting“) allowing substantial improvement of the image in contrast. Following our knowledge, this instrument is the first in the word with applied GaAs detektors of X-rays. Monolithic line GaAs X-ray sensor uses an original topology and technology developed. Base GaAs substrate has domestic origin (producer co. CMK sro., Žarnovica, Slovakia). Readout and control electronics, automatic positionning, control and imaging software were developed and fabricated in collaboration with the end-user. Fabricated digital scanner consist of 480 readout channels with the scanned area of 12x15 cm2, created by 843.750 points at the highest resolution (250 mm in the line direction and 80 mm in direction of the line movement). Control and imaging software allow to set length of the step, exposition duration and scanning trace length. Observed test X-ray images show high quality. The digital X-ray scanner was presented at the international trade fair INCHEBA, Bratislava 2004 within the exposition of the Slovak Academy of Sciences. The scanner was awarded by GOLD INCHEBA. This research result was obtained within the framework of domestic scientific-technical research project Modular imaging X-ray system utilizing radiation detectors based on GaAs semiconductor compound No. 2/9015/21 financed by the Ministry of Industry, Slovak Republic.

Result user: T&N System sro, Severná 5, Banská Bystrica. Partial product of the project, detection line with 144 readout channels (without automatic positionning), was recently selled to private company VF as, Cerná Hora (Czech Republic).

[3] Measuring heads with Hall Probes for the test coil manufactured in the frame of the program ITER Project number: FU06-CT-2003-00041

Financial support: The European Atomic Energy Community

Authors: M. Polák, J. Kvitkovič, P. Mozola.

In the frame of the project EFDA we developed measuring heads equipped with InSb Hall Probes for the measurements of the current redistribution in the cables used in windings of magnetic vessels. The magnetic vessels will serve for international experiments realized in the frame of the fusion research. Our heads will be used in the experiment PFCI (poloidal field coil insert). It is a one layer coil which will be tested in the external magnetic field produced by another superconducting coil on the test site in Naka, Japan, in 2006. The fabrication of the device is in the final phase in company TESLA, Storrington, UK, which ordered the development of the measuring heads in our Institute. We succeeded in fulfilling the high requirements on the sensitivity, precision of the Hall Probe location and their orientation in the measuring heads. The measuring head installed on the resistive cable model during testing

[4] Application of metal organic chemical vapour deposition technology thin metal films in advanced CMOS technology

Authors: K. Fröhlich, K. Hušeková, M. Ťapajna, A. Rosová

In the frame of the project with company Aixtron, Aachen, Germany we have prepared feasibility study of MOCVD process development for the application of electrodes and high-κ gate dielectrics. During the contract we have prepared and analysed thin films of Ru, TiN, TaN, RuSiO and we have studied MOS structures based on these gate electrode materials. Financial income from the contract for the period 2004 – 2006 was 60 000 €.

Používateľ: firma Aixtron AG., Kackertstrasse 15-17, D-52072 Aachen, Germany

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

[1] Ing. M. Polák, Drsc., delegate of SR in CERN financial committee

[2] Ing. M. Polák, DrSc., operating team member of ME SR for preparation of SR for entry into NATO

[3] Ing. D. Machajdík, CSc.,member of advisory board of government representative for cooperation of SR with JINR Dubna

[4] Ing. F. Gömöry, DrSc., operating team member of accreditation committee of Slovak government for electrotechnics and energetics

[5] RNDr. S. Takács, DrSc., member of Slovak committee for scientific degree of ME SR

[6] Doc. Ing. J. Novák, DrSc., leader of forecasting model “New materials and nanotechnologies”

[7] Ing. I. Vávra, CSc., member of forecasting model “New materials and nanotechnologies”. Forecast development and exploitation of research and technics up to 2015

[8] Ing. P. Lobotka, CSc., national contact point for 7th FP in the field of Nanotechnology

iii. List of the most important popularisation activities

[1] Day of open doors IEE, 230 participants, Nov. 2004

[2] Day of open doors IEE, 150 participants, Nov. 2005

[3] 2 Days of open doors IEE, 296 participants, May, Nov. 2006

[4] TV presentation (channel TA3)- Zlatá Incheba

[5] interview with the vice-chair of organizing committee of ASDAM conference, Slovak Radio, 18.10.2004

[6] Fröhlich, K.: Une realite particuliere: les caracteristiques et l´organisation de la recherche en Slovaquie. In: Evolutions du metier d´enseignant-chercheur et de chercheur. Universite de Reims Champagne Ardenne 2005, France, invited lecture on international seminar

[7] discussion with F. Gömöry about application of superconductivity, Slovak TV (STV2), 1.10.2005

[8] Biennal Report 2003-2004. Ed.: V. Cambel, A. Pevala, J. Osvald, M. Španková, P.Eliáš. Bratislava, EIÚ SAV 2005. 114 pages.

[9] CAMBEL, Vladimír - FEDOR, Ján - GREGUŠOVÁ, Dagmar - KÚDELA, Róbert. Hallovská magnetometria. In Československý časopis pro fyziku. Vol. 56, (2006), p.152-157.

[10] KOVÁČ, Pavol. Zlomený odpor. In Revue priemyslu. (2006), No. 2, pp. 70-71.

[11] UŠÁK, Pavol. Zažíhanie hviezdneho ohňa. (Sparking of the stellar flame), In Quark. (2006), č. 6, pp. 10-11.

[12] UŠÁK, Pavol. Zapaľovanie „hviezdneho ohňa“ na zemi (Ignition of “the stellar flame” on the Earth) In SME. Section Veda. 1.6.2006.

iv. List of patents issued abroad, incl. revenues

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v. List of the patents issued in Slovakia, incl. revenues

[2] Dubecký, F., Darmo, J., Pelfer, P.G., Kordos, P., and Förster, A.: *Detector of ionising radiation and methods of its preparation*, ČPV: PP 0538-95, ČP: P 282934

[3] Chromik, Š., Vincenc Oboňa, J.: *Using of the C60 resist mask in the process of superconducting thin film patterning in cryoelektronics,* No. 5101-2005

[4] Chromik, Š., Vincenc Oboňa, J., Kostič, I.: *Preparing of the submicrometer structures by patterning of the superconducting thin films with using a C60 resist mask*, No. 5016-2006

vi. List of licences sold abroad, incl. revenues

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vii. List of licences sold in Slovakia, incl. revenues

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viii. List of contracts with industrial partners, incl. revenues

[1] Design and manufacture of superconducting magnet, Tesla Engineering, UK, 2003, revenue 222 000 Sk,

[2] Design and manufacture of Hall probes, 2003, revenue 450 000 Sk,

[3] Manufacture of photodetectors, NATE Chotebor, 2003, 50 000 Sk

[4] Measurement of superconductors, Tampere Univ., Tampere, 2003, 140 000 Sk

[5] Synthesis of semiconductor material, Phostec, ltd. Zarnovica, Sk, 2003, revenue 80 000 Sk

[6] Design and manufacture of XRD detectors, 2003, revenue 33 000 Sk

[7] Design and manufacture of superconducting magnet, Max Planck Inst. Germany, 2004, revenue 177 000 Sk

[8] Design and manufacture of cryostat, Arepoc, Bratislava, 2004, 86 000 Sk

[9] Synthesis of semiconductor material, Phostec, ltd. Zarnovica, Sk, 2004, revenue 81 000 Sk

[10] Manufacture of photodetectors, NATE Chotebor, 2004, 44 000 Sk

[11] Measurement of superconductors, CERN, Geneve, 2004, 234 000 Sk

[12] Design and manufacture of XRD detectors, 2004, revenue 20 000 Sk

[13] Design and manufacture of Hall probes, 2004, revenue 23 000 Sk,

[14] Design and manufacture of Hall probes, 2005, revenue 293 000 Sk,

[15] Manufacture of photodetectors, NATE Chotebor, 2005, 68 000 Sk

[16] Design and manufacture of XRD detectors, 2005, revenue 100 000 Sk

[17] Manufacture of photodetectors, NATE Chotebor, 2006, 55 000 Sk

[18] Manufacture of XRD detectors, 2006, revenue 77 000 Sk

[19] Design and manufacture of Hall probes, 2006, revenue 38 000 Sk,

[20] Measurement of superconducting magnet, Oxford Instr. Nanoscience, Grenoble, revenue 52 000 Sk

ix. List of research projects with industrial partners, incl. revenues

[1] **Aixtron A.G.**, Project „MOCVD process development for the application of electrodes and high-κ gate dielectrics", 2004 – 2006, revenue 60 000 €

[2] **NES, Nová Dubnica**, common project , development of power optocoupler, 500 000 Sk.

x. Summary of outreach activities

Outreach activities	2003	2004	2005	2006	total
studies for the decision sphere, government and NGOs, international and foreign organisations	0	2	1	1	4
articles in press media/internet popularising results of science, in particular those achieved by the Organization	0	1	1	4	6
appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	0	2	1	0	3
public popularisation lectures	0	1	2	2	5

i. Supplementary information and/or comments on applications and popularisation activities

Since 2004 the Institute organises Open days. We invite mostly students from technical schools and colleges in Bratislava to the Institute. Demonstrations of low temperature physics, superconductivity, work with atomic force microscope, scanning electron microscope are showed to the students. More than 200 students visited the Institute during Open day in November 2006.

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

i. Summary table of personnel

Personnel	2003	2004	2005	2006
all personel	116	107	107	111
research employees from Tab. Research staff	58	61	62	65
FTE from Tab. Research staff	52.55	52.21	53.54	57.19
averaged age of research employees with university degree	46.7	46	47.5	46.9

ii. Professional qualification structure

Thanks to support from the European Social Fund, national agency APVV and Schwarz Fund (SAS) we were able to increase number of research employees from 58 in 2003 to

65 in 2006. The support was awarded to young researchers after completing their PhD study. Thanks to this concentrated effort we were able to keep the average age of research employees with university degree more less constant during the period 2003 – 2006. We were also succesfull to increase the number of PhD researchers during the period from 35 up to 38 during the period 2003 – 2006.

Number of	2003	2004	2005	2006
DrSc.	8	8	8	9
PhD / CSc.	35	34	37	38
Prof.	0	0	0	0
Doc./Assoc. Prof.	2	2	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)

The Institute is a contribution-based type of institution. It means that it has its own mechanism allowing to some extent renew the research infrastructure through depreciation of equipments. We were able to fill the fund for renovations of equipments approximately up to 7 000 000 Sk per year. However, this is limited by the revenues from the projects and contracts. In 2006 we were successful to acquire new AFM equipment for 4 000 000 Sk with the aid of APVV project. Even though the Institute is able to renew its equipments to some extent, it is not the case of larger equipments.

To concerted our effort since 2005 we have therefore created with other institutes of the Slovak Academy of Sciences consortium MULTIDISC. We have succeeded to acquire modern X-ray diffraction equipment Bruker D8 DISCOVER SUPER SPEED DIFFRACTION SYSTEM (worth 309 000 €) with rotating anode. The X-ray diffractometer is excellent tool for study of very thin films (~ 10 nm) in grazing incidence mode, X-ray reflectivity, texture and high resolution.

For the achievement of the objectives specified in the research concept we have prepared a list of equipments, including new technological equipments, optical lithography laboratory, etching equipment, He liquefier, measuring equipments for low

temperatures and superconductors testing. With other institutes of the SAS, oriented toward material research, we have initiated project of Technological Institute within Academy. We hope that through the concentrated effort within new Technological Institute we will able to receive some of these equipments within structural funds from the European Union, which includes for the period 2007- 2013.

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

Sources:

	2003	2004	2005	2006
Books	6940	6965	6998	7019
Serials	15	15	14	16

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

Services and activities:

- borrowings
- bibliographic information
- contributing to the central evidence of publication of SAS (EPCA) – 2000 entries
- contributing to the electronic book catalog (ARL – on-line access) – 1994 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

No special suggestions during the previous assessment were made.

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

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. 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.

Other information relevant to the assessment