INSTITUTE OF INORGANIC CHEMISTRY SAS

QUESTIONNAIRE

Period: January 1, 2012 - December 31, 2015

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doc. Ing. Miroslav Boča, DrSc.
Director of Institute

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

Period: January 1, 2012 - December 31, 2015

1. Basic information on the institute:

1.1. Legal name and address

Institute of Inorganic Chemistry, Slovak Academy of Sciences
Dúbravská cesta 9
SK-845 36 Bratislava
Slovak Republic

1.2. URL of the institute web site

http://www.uach.sav.sk/

1.3. Executive body of the institute and its composition

Directoriat	Name	Age	Years in the position
Director	doc. Ing. Miroslav Boča, DrSc. since 1.9.2013	42	2
Deputy director	doc. Ing. Miroslav Hnatko, PhD. since 1.9.2013	42	2
Scientific secretary	doc. Ing. Zoltán Lenčéš , PhD since 29.4.2014	51	1

Directoriat	Name	Age	Years in the position
Director	prof. RNDr. P. Šajgalík, DrSc. since 1999	61	14
Deputy director	doc. Ing. M. Boča, DrSc. since 2007	42	6
Scientific secretary	RNDr. J. Madejová, DrSc. since 5/2002	60	8

1.4. Head of the Scientific Board

RNDr. Jana Madejová, DrSc. - since 29.4.2014

RNDr. Peter Komadel, DrSc. - since 5/2002

1.5. Basic information on the research personnel

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

	2012		2013		2014		2015		total		
	number	FTE	number	FTE	number	FTE	number	FTE	number	averaged number per year	averaged FTE
Number of employees with university degrees	66.0	49.390	66.0	49.280	68.0	57.950	55.0	45.470	**255.0**	**63.8**	**50.523**
Number of PhD students	15.0	15.000	15.0	15.000	11.0	11.000	9.0	9.000	**50.0**	**12.5**	**12.500**
Total number	81.0	64.390	81.0	64.280	79.0	68.950	64.0	54.470	**305.0**	**76.3**	**63.023**

State on December 31, each year

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

Research staff	2012		2013		2014		2015		average	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
Institute in whole	66.0	49.390	66.0	49.280	68.0	57.950	55.0	45.470	**63.8**	**50.523**
Department of ceramics	12.0	9.300	11.0	9.550	11.0	9.650	8.0	7.380	**10.5**	**8.970**
Department of hydrosilicates	9.0	7.360	11.0	8.900	16.0	14.440	10.0	9.520	**11.5**	**10.055**
Department of molten systems	18.0	16.000	17.0	14.000	16.0	15.940	15.0	12.000	**16.5**	**14.485**
Department of theoretical chemistry	13.0	7.500	13.0	7.750	14.0	8.860	13.0	8.030	**13.3**	**8.035**
Vitrum Laugaricio	14.0	9.230	14.0	9.080	11.0	9.060	9.0	8.540	**12.0**	**8.978**

State on December 31, each year

1.6. Basic information on the funding of the institute

Institutional salary budget and others salary budget

Salary budget	2012	2013	2014	2015	average
Institutional Salary budget *[thousands of EUR]*	613.820	615.177	634.999	612.092	**619.022**
Other Salary budget *[thousands of EUR]*	216.100	256.873	353.427	257.401	**270.950**

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

The Foundation Charter from 27.8.2008 states:

1. The Institute of Inorganic Chemistry (IIC) is focused on basic research in the area of inorganic and bio-inorganic systems oriented to optimization and development of new materials and technological processes in the following branches of science:
   - Inorganic chemistry
   - Physical chemistry
   - Materials chemistry
   - Inorganic technologies and materials
   - Theoretical chemistry
   - Nanotechnology
2. The Institute performs scientific education pursuant to generally binding legal regulations.
3. The Institute provides consulting and expertise services related to the main activity of the Institute.
4. The main subjects of the research are the following:
   - Relations between composition, properties and structure of inorganic substances, mainly advanced ceramic materials, molten salt systems and hydrosilicates.
   - Thermodynamics of multicomponent systems.
   - Features and chemical reactions in inorganic systems, including interface of phases.
   - Development and application of theoretical and experimental methods for the determination of the structure and properties of matter.

The Mission Statement is still valid; however, since the year 2008 the Institute – in response to current scientific challenges – has systematically incorporated additional research subjects in related scientific areas.

1.8. Summary of R&D activity pursued by the institute during the assessment period in both national and international contexts, (recommended 5 pages, max. 10 pages)

This chapter contains a concise evaluation of the R&D activities (and also some related activities) within the assessed period and the analysis of the recent situation as seen by the contemporary representatives of the Institute.

Recent evaluation: In the previous evaluation period (2007-2011) the Institute was accredited in category A, which means obtaining the status: “An excellent organization, whose research fulfils international standards”. The annual evaluations of SAS institutes in the years 2012 – 2015 repeatedly confirmed the high rank of the Institute. It can be said that the Institute started the current assessment period in a strong position regarding science and personnel.

Research topics in context: The R&D activities pursued by the Institute mostly cover fundamental research, although some applied and industry-oriented research also plays an important role. The research topics of the Institute are mostly oriented towards inorganic materials and systems. The aim of the research is to provide a fundamental description of these materials; but there is also a considerable effort to prepare selected materials which have potential for practical usage. The objectives of the majority of the publications originating from the assessment period comprise the main subjects of the research of the Institute, i.e. relations between

composition, properties and structure of inorganic substances, thermodynamics and chemical reactions in inorganic systems and development and application of theoretical and experimental methods for the determination of the structure and properties of substances. The high-level experiences and competences of the Institute employees keep our research topics at a level of considerable interest from the wider scientific community. It should however be noted that while, in more scientifically-developed countries research activities are systematically supported not only by the respective governments but also by industry, in Slovakia support from the latter is minimal. The lack of significant external support, and the rather limited extent of governmental support, thus seriously hampers scientific development regardless of the field of interest.

Research achievements: As the Institute was established mainly for basic research, internationally recognised and accepted research achievements are the required "products" of the Institute activities. Due to the questionnaire limitations it is not possible to present all particularly important results. Therefore only selected results of each department will be listed in a concise form providing information on the importance of the results in the context of international research activity, on the role of the Institute in obtaining these results, and on the response of the scientific community.

Department of Molten Systems:

The research interests of the Department of Molten Systems comprise the investigation of physico-chemical (phase equilibria, density, electric conductivity, viscosity and surface tension), thermo-chemical (DTA, DSC, c_p), spectral (NMR, XPS, SIMS, IR) and diffraction (X-ray and neutron powder diffraction and single crystal analysis) properties of predominantly fluoride salts (based on zirconium, tantalum, niobium and aluminium) with additions of a variety of other compounds. Thermodynamic models as well as quantum-mechanical simulations were applied to better understand the relations between the composition and properties of the studied systems. The research activities of the Department were related to practical applications, particularly to optimization of conditions for electrochemical aluminium production, accumulation of solar energy, molten salts as transport and cooling media and investigation of corrosion of construction materials (alloys, special alloys, ceramics) in interaction with studied melts.

Application of modern spectroscopic methods for investigation of fluoride systems both in solid and liquid states was a primary focus. On the series of compounds NaF, K_2TaF_7, K_3TaF_8, K_2ZrF_6, $Na_7Zr_6F_{31}$ and K_3ZrF_7 a new method was developed for directly distinguishing between various bonding modes of fluorine atoms in powdered samples by application of X-ray photoelectron spectroscopy. Three bonding modes of fluorine atoms to the metallic centres are possible; ionic, terminal or bridging. Such direct information cannot be obtained from other techniques. This method can also be used for other light elements, thus providing fast analysis of the bonding properties of the analysed elements. Also, XPS signals from different orbitals were correlated with various NMR characteristics, together with structural characteristics, for the series of compounds $KTaF_6$, K_2TaF_7 and K_3TaF_8 and $KNbF_6$, K_2NbF_7 and K_3NbF_8. Such a correlation was presented for the first time.

- M. Boča, P. Barborík, M. Mičušík and M. Omastová. X-ray photoelectron spectroscopy as detection tool for coordinated or uncoordinated fluoride atoms demostrated on fluoride systems NaF, K_2TaF_7, K_3TaF_8, K_2ZrF_6, $Na_7Zr_6F_{31}$ and K_3ZrF_7. *Solid State Sciences* **14** (2012) 2028-2032. SCI citations: 2.
- M. Boča, A.Rakhmatullin, J. Mlynáriková, E. Hadzimová, Z. Vasková and M. Mičušík. Differences in XPS and Solid State NMR spectral data and thermo-chemical properties of iso-structural compounds in the series KTaF6, K2TaF7 and K3TaF8 and KNbF6, K2NbF7 and K3NbF8. Dalton Transactions **44** (2015) 17106-17117. SCI citations: 0.

Using NMR spectroscopy at high temperatures (HT) in the liquid as well as in the solid state (MAS), a question discussed in literature for more than 70 years on the formation of so called oxo-fluoro-aluminates was resolved. HT NMR and MAS NMR were applied to the systems of Na_3AlF_6-(Al_2O_3, Fe_2O_3 or FeO). It was found that specific oxo-fluoro-aluminates formed in the liquid phase

can vaporise, and after condensation they decompose to cryolite (Na_3AlF_6) and Al_2O_3. This result was achieved in cooperation with the CNRS team (CEMHTI-CNRS, Orléans, France) equipped with the most modern experimental setups. This observation is important for aluminium smelters all around the world, because any new knowledge about the processes that take place in production pots can be used in modelling of new generation pots, thus saving energy and reducing environmental impact.

- F. Šimko, A. Rakhmattulin, C. Bessada and M. Boča. MAS NMR study of the solidified cryolite systems with FeO addition. Journal of Fluorine Chemistry 165 (2014) 116−122. SCI citations: 0.

Systematic research of physico-chemical properties performed in the Department has provided the most integrated dataset yet of the volume properties of fluoride melts. The methodology for detailed analysis of volume properties like molar volume, excess molar volume, partial molar volume and excess partial molar volume was worked out. Such data are essential for the design of any industrial plant and we are not aware of any academic research team that can provide such consistent and precise data. Our data are now often used as reference data.

- B. Kubíková, V. Pavlík, I. Macková and M. Boča. Surface tension and viscosity of the molten $(LiF\text{-}NaF\text{-}KF)_{eut}\text{-}K_2ZrF_6$ system. Monatshefte fur Chemie - Chemical Monthly 143 (2012) 1459−1462. SCI citations: 1.
- B. Kubíková, I. Macková and M. Boča. Phase analysis and volume properties of the $(FLiNaK)_{eut}\text{-}K_2ZrF_6$ system. Monatshefte fur Chemie - Chemical Monthly 144 (2013) 295−300. SCI citations: 0.
- P. Barborík, Z. Vaskova, M. Boča and J. Priščák. Physicochemical properties of the system $(LiF\text{-}NaF\text{-}KF)_{eut}\text{-}Na_7Zr_6F_{31}$: Phase equilibria, density and volume properties, viscosity and surface tension. Journal of Chemical Thermodynamics 76 (2014) 145–151. SCI citations: 1.

A new method for accelerated corrosion testing on construction materials like superalloys in molten fluorides was developed. Various metal fluorides that can be considered as corrosion products of specific materials were added to the basic corrosion media for the system $FLINAK_{(eut)}\text{-}MF_x$ (MF_x = CrF_3, FeF_2, FeF_3 and NiF_2) plus Incoloy 800H/HT. This method represents a new approach to long term corrosion tests, which might shorten corrosion investigations from thousands to dozens of hours.

- V. Pavlík, M. Kontrík and M. Boča. Corrosion behaviour of Incoloy 800H/HT in fluoride molten salt $FLINAK_{(eut)}\text{-}MF_x$ (MF_x = CrF_3, FeF_2, FeF_3 and NiF_2), New Journal of Chemistry **39** (2015) 9841- 9847. SCI citations: 1.

Department of Theoretical Chemistry:

The Department of Theoretical Chemistry has been engaged in three main research areas. Activities in the first field of research have been focused on developing advanced computational methods for treating electron correlation in molecules and solids. The second area has covered studies on magnetic and electric properties of medium-sized systems including calculations of NMR and EPR parameters of biologically and catalytically active organometallic substances. The objective of the third research field combined the experimental methods (X-ray and neutron structure analysis, vibrational spectroscopy by inelastic neutron scattering) with precise DFT calculations in the solid state.

Progress in theoretical prediction and interpretation of paramagnetic NMR spectra: Paramagnetic nuclear magnetic resonance spectroscopy (pNMR) is a powerful experimental method used for determination of three-dimensional structures of chemical and biochemical molecules including complex biological systems in solution. The pNMR method is able to provide information about distances between a paramagnetic center (an atom possessing an unpaired electron) serving as a label and nuclei with nonzero magnetic moments such as ^{1}H and ^{13}C. Typically-employed labels are transition metals and lanthanides. Different labels allow one to cover a range of 40 Angstrom or more from the paramagnetic center. Information about the distances between the paramagnetic center and remote nuclei can be extracted from measured NMR shifts using structure-property relations, either empirical or based on simplified models. To improve the accuracy of structure determination, more accurate structure-property relations obtained from

advanced quantum-chemical calculations are required. Since the compounds under study contain heavy transition metals or lanthanides the inclusion of relativistic effects into theoretical consideration is mandatory. With this in mind we developed a new relativistic method based on the Dirac-Kohn-Sham equation for the calculation of NMR shielding constants of paramagnetic doublet systems. The evaluation of paramagnetic nuclear magnetic resonance (pNMR) tensors consists of fully relativistic calculations of electronic g-tensors, hyperfine coupling tensors, and NMR shielding tensors. Benchmark calculations on Ru(III) complexes demonstrated good performance of the method in reproducing experimental data and its applicability for studying chemically-relevant medium-sized systems.

- S. Komorovský, M. Repiský, K. Ruud, O.L. Malkina and V.G. Malkin. Four-Component Relativistic Density Functional Theory Calculations of NMR Shielding Tensors for Paramagnetic Systems. Journal of Physical Chemistry A **117** (2013) 14209−14219. SCI citations: 7.

Dispersion corrections for density functional theory: Density functional theory (DFT) is a workhorse of modern computational chemistry and materials science. The DFT methodology has indeed been successful in determining various properties of covalent and ionic species; nevertheless, it has also been known to fail in describing an important class of interactions, namely the London dispersion forces. Up until recently, this deficiency seriously limited progress in theoretical investigation of layered materials or biomolecular systems. In our recent series of studies, we significantly contributed to the solution of the above-mentioned problem. First, we systematically tested performance of the Tkatchenko and Scheffler (TS) dispersion correction method in a number of applications including description of structure, energetics, and elastic properties of various materials. We identified ionic systems as an important class of materials for which the TS correction method fails and proposed a new variant of the method (TS/HI) that solves this serious problem. As we demonstrated in a detailed study, our correction method significantly improves predictions for the ionic materials, while the generally good performance of the original scheme for other classes of materials is maintained. Such a balanced description of diverse bonding situations in a single generic procedure is absolutely indispensable in realistic atomic-scale simulations. Importantly, all the methodology developed within this series of studies has been implemented into the periodic DFT program VASP (see http://cms.mpi.univie.ac.at/vasp/vasp/IVDW_approximate_vdW_correction_methods.html for a detailed list of methods). With users in more than 600 different research laboratories and university departments, this program is currently one of the most widely used ab-initio DFT codes worldwide. Our work has therefore had a considerable impact on the wider community of computational chemists and materials scientists.

- T. Bučko, S. Lebègue, J. Hafner and J. G. Ángyán. Tkatchenko-Scheffler van der Waals correction method with and without self-consistent screening applied to solids. Physical Review B **87** (2013) 064110. SCI citations: 76.
- T. Bučko, S. Lebègue, J. Hafner and J. G. Ángyán. Improved Density Dependent Correction for the Description of London Dispersion Forces. Journal of Chemical Theory and Computation **9** (2013) 4293-4299. SCI citations: 12.
- T. Bučko, S. Lebègue, J. G. Ángyán and J. Hafner. Extending the applicability of the Tkatchenko-Scheffler dispersion correction via iterative Hirshfeld partitioning. Journal of Chemical Physics **141** (2014) 034114. SCI citations: 7.

Department of Ceramics:

The primary interest of the Department of Ceramics is in understanding the relations between microstructural and mechanical properties of oxide/non-oxide ceramic nano/micro-composites and ceramic/metal composites. Microstructural design of new types of composites with excellent functional (e.g. high thermal and/or electrical conductivity) and mechanical properties, luminescent materials, corrosion and oxidation resistant materials, etc. is a primary area of research. The experimental research is combined with theoretical ab-initio approaches for the design and explanation of engineering and functional properties of ceramics. Part of the research is focused on the development of bioceramics based on silicon oxynitride–hydroxyapatite composites. Another branch of research is oriented towards the design of new types of refractories containing

oxycarbide or oxynitride ceramic phases. This part of research is closely associated with collaboration with industry.

Silicon oxynitride-based bioceramics with microstructure and mechanical properties similar to the human trabecular bone have been developed. Different pore-forming agents like semolina and polyurethane sponge and different sintering techniques like sintering on air or reaction bonding were used to achieve the desired goal. The porous silicon oxynitride (SiON) ceramics showed very good biocompatibility and were coated with a bioactive component in the form of hydroxyapatite (HA). The preliminary biological tests of SiON-HA composites are promising and this novel biomaterial could be a candidate for use in orthopaedic surgery for the reconstruction of bones.

- K. Bodišová, M. Kašiarová, M. Domanická, M. Hnatko, Z. Lenčéš, Z.V. Nováková, J. Vojtaššák, S. Gromošová and P. Šajgalík. Porous silicon nitride ceramics designed for bone substitute applications. Ceramics International **39** (2013) 8355–8362. SCI citations: 7.

Functional alumina/multi-wall carbon nanotube (MWCNT) composites have been prepared by a new approach. This process comprises the functionalization of MWCNTs by acid treatment, stabilization of the alumina-MWCNT dispersion, and freeze granulation. The freeze granulation process makes it possible to retain the homogeneous distribution of MWCNTs achieved in the suspension even in the granulated powder. The ceramic composites were densified by rapid hot pressing. This novel approach allowed an increase of eight orders of magnitude in the electrical conductivity of the alumina matrix, reaching a value of 1400 S/m. The novel freeze-granulation-based approach for the homogeneous distribution of CNTs or graphene in ceramic matrix can be applied also to other systems (Si_3N_4, SiC), whose electrical conductivity can be varied over a wide range, opening up new fields of industrial applications of these nanocomposites.

- O. Hanzel, J. Sedláček and P. Šajgalík. New approach for distribution of carbon nanotubes in alumina matrix. Journal of European Ceramic Society **34** (2014) 1845−1851. SCI citations: 7.

Silicon oxynitride-based phosphors. A cost effective method was used for the preparation of silicon oxynitride-based phosphors, either by combination of Si_3N_4 with SiXOCN (where X = Al, Hf, Lu) polymer precursors, or by nitridation of metal silicides and doping with lanthanide (Ln = Eu, Ce, Sm, Nd) oxides. The photoluminescence (PL) measurements of polymer-precursor-derived phosphors showed that, depending on the host lattice (O-sialon or β-sialon), on the substitution level Si/Al and N/O, and on the doping Ln (Ln = Eu, Sm, Ce) content, it was possible to prepare blue, green, orange and red light-emitting phosphors. The PL measurements of phosphors prepared from metal silicides showed that, by appropriate combination of host lattice ($MgSiN_2$ or $LaSi_3N_5$) and lanthanide dopant, the whole visible light region can be covered. The experimental approach was also combined with first-principles density-functional theory (DFT) calculations to enhance understanding of the electronic structure of $LaSi_3N_5$-based phosphors. The calculated band gaps were in reasonable agreement with experimental data and can help to decrease the required number of experiments for the development of new phosphors.

- I.A.M. Ibrahim, Z. Lenčéš, L. Benco, M. Hrabalová and P. Šajgalík: Cerium-doped $LaSi_3N_5$: computed electronic structure and band gaps. Journal of European Ceramic Society **34** (2014) 2705–2712. SCI citations: 0.
- I.A.M. Ibrahim, Z. Lenčéš, L. Benco, M. Hrabalová, P. Šajgalík: Samarium-doped $LaSi_3N_5$: synthesis, computed electronic structure and band gaps. Journal of American Ceramic Society **97** (2014) 2546–2551. SCI citations: 0.

Department of Hydrosilicates:

The research activities of the department during the assessment period has been focused on the mineralogical and chemical characterization of the fine fractions of bentonites, the clay raw materials containing dominantly montmorillonite or other minerals of the smectite group. The main objective was to prepare attractive novel materials by modification of smectites with inorganic acids, variety of organic substances and dyes. Besides synthesis of the functional materials the research has been oriented to the development of new advanced techniques of IR, UV-VIS and fluorescent spectroscopies used for deeper/systematic characterisation of the properties of

organoclays used in clay-polymer nanocomposites, and for description of the photophysical phenomena and properties of the hybrids with organic dyes. The fruitful collaboration of the department with different national and foreign institution has provided space for widening the research horizon of department to several other fields such as synthesis of porous heterostructures for catalysis, organoclays for agricultural wastewater treatment, and clay/antibacterial drug hybrids.

Hybrid materials involving photoactive organic dyes is the newest research topic of the department. Using templates of layered silicates, one is able to sensitively control the structure of dye supramolecular assemblies and the photophysical and optical properties of the resulting hybrid material. In recent years incorporation of more complex materials has been investigated, as well as incorporation of third components, such as surface active compounds and modifiers. Highly photoactive materials were successfully developed using a silicate template modification and by optimization of the materials' structure. The hybrid materials involved layer-by-layer assemblies, ternary colloids and gels and thin optical films of controllable structure. The most interesting properties, *i.e.* photophysical and photochemical phenomena of these materials included high luminescence, optical anisotropy, photosensitization, and resonance transfer of light energy.

- J. Bujdák. Layer-by-layer assemblies composed of polycationic electrolyte, organic dyes, and layered silicates. Journal of Physical Chemistry C **118** (2014) 7152-7162. SCI citations: 5.
- A. Czímerová, Ľ. Jankovič, J. Madejová and A. Čeklovský. Unique photoactive nanocomposites based on rhodamine 6G/polymer/montmorillonite hybrid systems. Journal of Polymer Science. Part B. Polymer Physics **51** 2013 1672-1679. SCI citation: 3.

Clay-polymer nanocomposites are nowadays very attractive materials in multidisciplinary research due to their enormous potential in various applications. They consist of two or more phases with a clay mineral acting as a nanomaterial component. Hydrophilicity is disadvantageous for interactions with hydrophobic polymers, so organic modification of the surface of the clay mineral is essential. Information on the extent of interaction with the components and on the orientation and distribution of organocations in the interlayers of a clay mineral may help in the selection of appropriate surfactants for particular polymer applications, because the properties of the organoclays significantly affect the final properties of the nanocomposite. The main contribution of the department lies in the utilization of non-conventional commercial and new synthetic surfactants based on octadecylamine derivatives and in the design of a procedure for optimization of clay mineral surface modification tailored to an individual polymeric matrix.

- Ľ. Jankovič, J. Kronek, J. Madejová and V. Hronský. (9,10-Dihydroxyoctadecyl) ammonium: A structurally unique class of clay intercalable surfactants. European Journal of Inorganic Chemistry (2015) 2841-2850. SCI citations: 0.
- J. Bujdák. Effect of layer charge on the formation of polymer/layered silicate nanocomposites: Intercalation of polystyrene. Journal of Physical Chemistry C **119** (2015) 12016-12022. SCI citations: 1.

Acid-treated organoclays represent an attractive group of hybrid materials due to their application potential as cost-effective hydrophobic catalysts of relatively high acidity. The research directed to the influence of a harsh acid environment on the stability of organo-modified clays is of potential interest, because much attention is currently paid to the preparation of clay-based systems with modular drug delivery properties using various organic species (pharmaceuticals, biocomponents *etc.*). Surface modification with organic cations provides materials able to withstand acid conditions, e.g. in the digestive system. The research of the department has contributed to the general knowledge on the stability of organoclays, which is superior to that of the original clay minerals. A combination of ^{29}Si, ^{13}C CP, ^{27}Al MAS NMR and IR spectroscopic methods was used to obtain, for the first time, a deeper insight into the structural changes of organoclays upon acid treatment. The presence of organic cations significantly reduced the decomposition rate of the clay minerals. Despite extreme conditions, organic matter was still present in the samples after the treatment. IR spectroscopy was used to characterize the acidity of the materials, a parameter which is important in catalytic reactions. This was performed through the adsorption of a pyridine probe. In addition to the traditionally-used mid-IR spectra, the near-IR spectra also allowed

identification of H-bonded pyridine molecules and/or pyridinium cations, thus providing complementary information on the character of the acid sites.

- H. Pálková, V. Hronský, Ľ. Jankovič and J. Madejová. The effect of acid treatment on the structure and surface acidity of tetraalkylammonium-montmorillonites. Journal of Colloid and Interface Science **395** (2013) 166-175. SCI citations: 2.
- J. Madejová, H. Pálková and Ľ. Jankovič. Near-infrared study of the interaction of pyridine with acid-treated montmorillonite. Vibrational Spectroscopy **76** (2015) 22-30. SCI citations: 0.

Vitrum Laugaricio

The research at the Joint Glass Centre Vitrum Laugaricio (VILA) is focused on two mutually-related areas in the field of oxide-based non-metallic inorganic materials. The first area focuses on relations between the composition, structure and properties of oxide glasses. The main topics included the volumetric studies, structural and enthalpy relaxation processes in silicate glasses, thermodynamic modelling and molecular dynamic simulations of the structure of glasses, study of processes during glass batch melting, and the electrochemistry of glasses and glass melts. Equally important research objectives included the development and optimisation of new glasses for industrial applications, and corrosion of glasses by aqueous media. Special attention was also paid to the preparation of glasses without a typical glass-former (e.g. aluminate glasses) and to the characterisation of their optical and photoluminescence properties. The second field of research included study of the processing, microstructure, and properties of polycrystalline ceramic materials. This included the study of polycrystalline alumina-based materials, with a special focus on the liquid phase-sintered (LPS) aluminas, solid state-sintered aluminas with submicron microstructure transparent for visible light, and alumina-based ceramic matrix composites with improved mechanical properties (wear, creep). Other topics included corrosion of structural ceramic materials, including bioceramics, in aqueous media, and polymer-derived glass ceramic coatings for high-temperature corrosion protection of metals.

The chemical durability of gamma-irradiated glass fibrous insulation commonly used in nuclear power plant reactor containment was tested by static leaching tests at 90°C. In distilled water, higher normalized amounts of leached calcium were found for low-temperature irradiated glass fibers and in the initial stage of leaching of high-temperature irradiated glass fibers, while lower normalized leached amounts were found for boron for glasses irradiated at both temperatures. In the borate coolant solution, higher normalized amounts of leached calcium and lower amounts of leached aluminum were observed for glasses irradiated at both temperatures. In all cases the results were comparable for both applied radiation doses. An extraordinary brittleness of glass fibers was observed after their irradiation at high temperatures. These new findings call for further experimental and theoretical investigation.

- M. Chromčíková, J. Vokelová, J. Michálková, M. Liška, J. Macháček,O. Gedeon and V. Soltész. Chemical Durability of Gamma – Irradiated Glass Fibrous Insulation. Nuclear Technology **193** (2016) 297-305. SCI citations: 0. – submitted in 2015

The new method for the preparation of Al_2O_3-RE_2O_3-(SiO_2, ZrO_2) glasses, where RE=Y, Yb, La and Al_2O_3-CaO-SiO_2 doped with optically active elements, e.g. Eu, Er, Nd, V, Bi, Cr, Mn was developed. The relationship between the composition, structure and luminescence properties was investigated in detail. Special attention was paid to study the influence of crystallization on the wavelength and intensity of emitted light. The glasses, depending on the photoactive element, emitted intensive light in the red or green part of the visible spectrum. In several cases remarkable differences in the emission intensity or in the emission band broadening were observed between glasses and their crystalline counterparts were observed. Aluminate glasses can accommodate high concentration of optically active dopants, and have a great potential for optical application, such as solid state lasers and HB-LEDs.

- E. Bernardo, L. Fiocco, A. Prnová, R. Klement and D. Galusek. Gehlenite: Eu^{3+} phosphors from a silicone resin and nano-sized fillers. Optical Materials 36 (2014) 1243-1249. SCI citations: 1.

A new method of parameterization of the thermodynamic model of Shakhmatkin and Vedishcheva was proposed based on known structural data. A thermodynamic model was constructed for the ZnO-MoO_3-P_2O_5 glasses. On the basis of equilibrium phase diagrams and the crystal structural data, the glass was considered as an ideal solution of three oxides and nine compounds. For the components considered in the model no thermodynamic data were available in contemporary thermodynamic databases. For four compositional series the Q^n distribution was obtained from the ^{31}P MAS NMR spectra. Using these experimental data the temperature-independent Gibbs reaction energies for formation of compounds considered in the thermodynamic model were estimated by minimization of the sum of squared deviations between experimental and calculated relative abundances of Q^n units.

- M. Liška, J. Macháček, M. Chromčíková and O. Gedeon. Thermodynamic model and structure of ZnO-MoO3-P2O5 glasses. Physics and Chemistry of Glasses: European Journal of Glass Science and Technology Part B **52** (2015) 63-66. SCI citations: 0.

Alumina-based ceramics with high creep resistance are potential candidates as structural materials for use under extreme temperatures and pressures. The research was focused on detailed investigation of the influence of volume fraction and granulometry of the added SiC nanoparticles on the creep resistance of alumina ceramics. A new material containing 10 vol. % of SiC nanoparticles with a mean size of 200 nm homogeneously distributed in the alumina matrix and with extremely high creep resistance was prepared by optimization of sintering conditions. This material, in comparison to monolithic alumina reference, exhibited several orders of magnitude higher creep resistance (bending deformation at a level of only 0.08 %, under a load of 200 MPa, after 150 h of isothermal heating at 1350 °C – in comparison to monolithic alumina, which failed after only 30 minutes at the same temperature and 150 MPa load). The obtained results allowed identification of mechanisms of creep resistance enhancement in the nanocomposites.

- M. Parchovianský, D. Galusek, M. Michálek, P. Švančárek, M. Kašiarová, J. Dusza and M. Hnatko. Effect of the volume fraction of SiC on the microstructure and creep behavior of hot pressed Al2O3/SiC composites. Ceramics International 40 (2014) 1807-1814. SCI citations: 2.

National and international cooperation

The Institute has broad international contacts with scientists all over the world, leading to international collaboration in all main research activities (see 2.3.1). The Institute's generally accepted position in the European Research Area (ERA) is shown as well by our many international or bilateral projects. The Institute also provides access to equipment and materials for incoming scientists from abroad for short or longer stays.

Human sources

In the assessment period the policy of improving the qualification level of researchers of the Institute was maintained. Two professorships and one associate professorships were awarded (bringing us to 5 professors and 7 associate professors), one DrSc. was defended successfully (bringing us to 9 DrSc. degrees including part-time job employees) and 9 PhD. theses were defended, as well. Although several PhD. students finish their study every year, they usually cannot be employed at the Institute, which is a significant barrier for the Institute's growth. On the other hand our PhD. students who successfully defended their theses usually received superior positions either at the universities or in the industry, both in Slovakia and abroad. In the assessment period two colleagues got permanent jobs in Hydro (Norway) and in Sabic (the Netherlands). Other young colleagues spent a period abroad in foreign institutions. In 2015 three SASPRO scholarships were awarded to the Institute. These human resource transfers or exchanges provided the Institute a valuable source of information, cooperation and reputation.

2. Partial indicators of main activities:

2.1. Research output

2.1.1. Principal types of research output of the institute: basic research/applied research, international/regional (ratios in percentage)

The institute is mainly oriented towards fundamental research, but applied research is not excluded. The amount of the latter depends on the interest of industrial partners. The ratio of basic to applied research can be estimated as 3:1. The research activities of the Institute are oriented mostly to the international research area, although some regional research is also present. The ratio of international to regional research is ca. 9:1.

The level of co-operation with industry is expected to increase in the next years. Nevertheless, we shall continue to pay significant attention to the excellence in the fundamental research which forms a necessary basis for advanced applied research. To achieve this aim it is necessary to have high quality human resources. Involvement in international research consortia and projects should create a framework for this effort. All these activities should lead to an increase in the quality of research performed at the Institute.

2.1.2 List of selected publications documenting the most important results of basic research. The total number of publications listed for the assessment period should not exceed the average number of employees with university degrees engaged in research projects. The principal research outputs (max. 5, including Digital Object Identifier - DOI) should be underlined

The following selection of publications has been chosen to cover as much of the diversity of the research conducted by the Institute, and as many of the researchers involved, as possible. Consequently, it is not a list of papers published in the highest-impact journals, but rather a list of the most important papers within individual fields of interest.

Full time equivalent work capacity (FTE) of the employees with university degrees engaged in research projects (Table 1.5.1.): - 63 employees.

Department of Molten Systems:

[1] **BOČA, Miroslav - RAKHMATULLIN, Aydar - MLYNÁRIKOVÁ, Jarmila - HADZIMOVÁ, Eva - VASKOVÁ, Zuzana - MIČUŠÍK, Matej. Differences in XPS and solid state NMR spectral data and thermo-chemical properties of iso-structural compounds in the series KTaF6, K2TaF7 and K3TaF8 and KNbF6, K2NbF7 and K3NbF8. In Dalton Transactions, 2015, vol. 44, p. 17106-17117. (4.197 - IF2014). (2015 - Current Contents). ISSN 1477-9226. DOI: 10.1039/c5dt02560e.**

[2] PAVLÍK, Viliam - KONTRÍK, Martin - BOČA, Miroslav. Corrosion behavior of Incoloy 800H/HT in the fluoride molten salt FLiNaK + MFx (MFx = CrF3, FeF2, FeF3 and NiF2). In New Journal of Chemistry, 2015, vol. 39, p. 9841-9847. (3.086 - IF2014). (2015 - Current Contents). ISSN 1144-0546.

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[8] ŠIMKO, František - RAKHMATULLIN, Aydar - BESSADA, Catherine - BOČA, Miroslav. MAS NMR study of the solidified cryolite systems with FeO addition. In Journal of Fluorine Chemistry, 2014, vol. 165, p. 116-122. (1.952 - IF2013). (2014 - Current Contents). ISSN 0022-1139.

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Vitrum Laugaricio:

[55] BODIŠOVÁ, Katarína - GALUSEK, Dušan - ŠVANČÁREK, Peter - POUCHLÝ, Václav - MACA, Karel. Grain growth suppression in alumina via doping and two-step sintering. In Ceramics International, 2015, vol. 41, no. 9, p. 11975-11983. (2.605 - IF2014). (2015 - Current Contents). ISSN 0272-8842

[56] GALUSEK, Dušan - SEDLÁČEK, Jaroslav - CHOVANEC, Jozef - MICHÁLKOVÁ, Monika. The influence of MgO, Y2O3 and ZrO2 additions on densification and grain growth of submicrometre alumina sintered by SPS and HIP. In Ceramics International, 2015, vol. 41, p. 9692-9700. (2.605 - IF2014). (2015 - Current Contents). ISSN 0272-8842.

[57] GALUSEK, Dušan - GALUSKOVÁ, Dagmar. Alumina matrix composites with non-oxide nanoparticle addition and enhanced functionalities. In NANOMATERIALS-BASEL, 2015, vol. 5, no. 1, p. 115-143. (2.076 - IF2014). (2015 - Current Contents). ISSN 2079-4991

[58] CHROMČÍKOVÁ, Mária - LIŠKA, Marek - ZEMANOVÁ, Vladimíra - PLŠKO, Alfonz - HRUŠKA, Branislav - GAVENDA, Tadeáš. Thermodynamic model and Raman spectra of CaO-P2O5 glasses. In Journal of Thermal Analysis and Calorimetry, 2015, vol. 121, no. 1, p. 269-274. (2.042 - IF2014). (2015 - Current Contents). ISSN 1388-6150.

[59] LIŠKA, Marek - LISSOVÁ, Magdaléna - PLŠKO, Alfonz - CHROMČÍKOVÁ, Mária - GAVENDA, Tadeáš - MACHÁČEK, Jan. Thermodynamic model and Raman spectra of ZnO-P2O5 glasses. In Journal of Thermal Analysis and Calorimetry, 2015, vol. 121, no. 1, p. 85-91. (2.042 - IF2014). (2015 - Current Contents). ISSN 1388-6150.

[60] CHROMČÍKOVÁ, Mária - LIŠKA, Marek - GAVENDA, Tadeáš - MACHÁČEK, Jan. Structure of Na2O-MgO-CaO-SiO2 glasses by combined Raman spectroscopy and thermodynamic modeling approach. In Journal of Thermal Analysis and Calorimetry, 2014, vol. 118, no. 2, p. 835-840. (2.206 - IF2013). (2014 - Current Contents). ISSN 1388-6150

[61] DOMANICKÁ, A. - KLEMENT, Róbert - PRNOVÁ, Anna - BODIŠOVÁ, Katarína - GALUSEK, Dušan. Luminescent rare-earth ions doped Al2O3-Y2O3-SiO2 glass microspheres prepared by flame synthesis. In Ceramics International, 2014, vol. 40, p. 6005-6012. (2.086 - IF2013). (2014 - Current Contents). ISSN 0272-8842.

[62] GALUSKOVÁ, Dagmar - KAŠIAROVÁ, Monika - HNATKO, Miroslav - GALUSEK, Dušan - DUSZA, Ján - ŠAJGALÍK, Pavol. Hydrothermal corrosion and flexural strength of Si3N4-based ceramics. In Corrosion Science, 2014, vol. 85, p. 94-100. (3.686 - IF2013). (2014 - Current Contents). ISSN 0010-938X. DOI:10.1016/j.corsci.2014.04.005

[63] PARCHOVIANSKÝ, Milan - GALUSEK, D. - MICHÁLEK, M. - ŠVANČÁREK, P. - KAŠIAROVÁ, Monika - DUSZA, Ján - HNATKO, Miroslav. Effect of the volume fraction of SiC on the microstructure and creep behavior of hot pressed Al2O3/SiC composites. In Ceramics International, 2014, vol. 40, p. 1807-1814. (2.086 - IF2013). (2014 - Current Contents). ISSN 0272-8842.

[64] PARCHOVIANSKÝ, Milan - GALUSEK, Dušan - ŠVANČÁREK, Peter - SEDLÁČEK, Jaroslav - ŠAJGALÍK, Pavol. Thermal behavior, electrical conductivity and microstructure of hot pressed Al2O3/SiC nanocomposites. In Ceramics International, 2014, vol. 40, p. 14421-14429. (2.086 - IF2013). (2014 - Current Contents). ISSN 0272-8842.

[65] PRNOVÁ, Anna - BODIŠOVÁ, Katarína - KLEMENT, R. - MIGÁT, M. - VETEŠKA, P. - ŠKRÁTEK, Martin - BRUNEEL, E. - VAN DRIESSCHE, I. - GALUSEK, Dušan. Preparation and characterization of Yb2O3-Al2O3 glasses by the Pechini sol-gel method combined with flame synthesis. In Ceramics International, 2014, vol. 40, p. 6179-6184. (2.086 - IF2013). (2014 - Current Contents). ISSN 0272-8842.

[66] PARCHOVIANSKÝ, Milan - GALUSEK, Dušan - SEDLÁČEK, Jaroslav - ŠVANČÁREK, Peter - KAŠIAROVÁ, Monika - DUSZA, Ján - ŠAJGALÍK, Pavol. Microstructure and mechanical properties of hot pressed Al2O3/SiC nanocomposites. In Journal of the European Ceramic Society, 2013, vol. 33, p. 2291-2298. (2.360 - IF2012). (2013 - Current Contents, WOS, SCOPUS). ISSN 0955-2219.

2.1.3 List of monographs/books published abroad

2.1.4. List of monographs/books published in Slovakia

2.1.5. List of other scientific outputs specifically important for the institute, max. 10 items

Chapters in monographs published abroad:

[1] KOMADEL, Peter - MADEJOVÁ, Jana. Acid activation of clay minerals. In Handbook of Clay Science. A.Fundamentals. Second edition. - Oxford : Elsevier, 2013, p. 385-410. ISBN 978-0-08-098259-5. ISSN 1572-4352.

[2] PETIT, Sabine - MADEJOVÁ, Jana. Fourier transform infrared spectroscopy. In Handbook of Clay Science. B.Techniques and Applications. Second edition. - Oxford : Elsevier, 2013, p. 213-232. ISBN 978-0-08-098258-8. ISSN 1572-4352.

[3] GALUSEK, Dušan - SEDLÁČEK, Jaroslav - KLEMENT, Róbert - ŠVANČÁREK, Peter. Silicon carbide-containing alumina nanocomposites: processing and properties. In Advances in ceramic matrix composites. - UK : Woodhead Publishing Limited, 2014, p. 43-78. ISBN 978-0-85709-120-8.

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

Japanese patents:

[1] Application No. 2006-014576
Patent No. **JP 5046221**,
Registration date: July 27, 2012
Title: “Fabrication method of high thermal conductivity silicon nitride ceramics with high mechanical reliability”,
Inventors: Kiyoshi Hirao, You Zhou, Xinwen Zhu, and Zoltán Lenčéš

[2] Application No. 2006-014670
Patent No. **4997431**
Registration date: May 25, 2012
Title: “High thermal conductivity silicon nitride substrate and process for its production”,
Inventors: Kiyoshi Hirao, You Zhou, Xinwen Zhu, Zoltán Lenčéš, Yasuo Imamura, and Masahiro Imamura.

[3] Application No. 2007-097877
Patent No. **5077930**
Registration date: September 7, 2012
Title: “Preparation of nitride phosphors by combustion synthesis”
Inventors: Kiyoshi Hirao, You Zhou, Zoltán Lenčéš.

European patent:

[1] Application No.: 12 192 453.4
Application date: 13.11.2012
Patent No.: **EP 2730551 A1**
Registration date: 14.05.2014
Title: Verfahren zur Herstellung eines feuerfesten Werkstoffes auf Basis von Magnesia oder Magnesia-Spinell sowie ein feuerfester Werkstoff auf Basis von Magnesia oder Magnesia-Spinell.
Inventors: Harald Harmuth, Sabine Gschiel, Zoltán Lenčéš, Pavol Šajgalík

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

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

Papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) have to be listed separately.

Scientific publications	2012			2013			2014			2015			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
Scientific monographs and monographic studies in journals and proceedings published abroad *(AAA, ABA)*	1.0	0.016	0.002	0.0	0.000	0.000	0.0	0.000	0.000	0.0	0.000	0.000	**1.0**	**0.3**	**0.004**	**0.000**
Scientific monographs and monographic studies in journals and proceedings published in Slovakia *(AAB, ABB)*	0.0	0.000	0.000	0.0	0.000	0.000	0.0	0.000	0.000	0.0	0.000	0.000	**0.0**	**0.0**	**0.000**	**0.000**
Chapters in scientific monographs published abroad *(ABC)*	0.0	0.000	0.000	2.0	0.031	0.003	1.0	0.015	0.002	0.0	0.000	0.000	**3.0**	**0.8**	**0.012**	**0.001**
Chapters in scientific monographs published in Slovakia *(ABD)*	0.0	0.000	0.000	0.0	0.000	0.000	0.0	0.000	0.000	0.0	0.000	0.000	**0.0**	**0.0**	**0.000**	**0.000**
Scientific papers published in journals registered in Current Contents Connect *(ADCA, ADCB, ADDA, ADDB)*	56.0	0.870	0.091	57.0	0.887	0.093	51.0	0.740	0.080	47.0	0.863	0.077	**211.0**	**52.8**	**0.837**	**0.085**
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS *(ADMA, ADMB, ADNA, ADNB)*	7.0	0.109	0.011	2.0	0.031	0.003	4.0	0.058	0.006	4.0	0.073	0.007	**17.0**	**4.3**	**0.067**	**0.007**
Scientific papers published in other foreign journals (not listed above) *(ADEA, ADEB)*	1.0	0.016	0.002	1.0	0.016	0.002	0.0	0.000	0.000	2.0	0.037	0.003	**4.0**	**1.0**	**0.016**	**0.002**
Scientific papers published in other domestic journals (not listed above) *(ADFA, ADFB)*	7.0	0.109	0.011	3.0	0.047	0.005	0.0	0.000	0.000	0.0	0.000	0.000	**10.0**	**2.5**	**0.040**	**0.004**
Scientific papers published in foreign peer-reviewed proceedings *(AEC, AECA)*	2.0	0.031	0.003	7.0	0.109	0.011	6.0	0.087	0.009	0.0	0.000	0.000	**15.0**	**3.8**	**0.060**	**0.006**
Scientific papers published in domestic peer-reviewed proceedings *(AED, AEDA)*	1.0	0.016	0.002	12.0	0.187	0.020	2.0	0.029	0.003	0.0	0.000	0.000	**15.0**	**3.8**	**0.060**	**0.006**
Published papers (full text) from foreign and international scientific conferences *(AFA, AFC, AFBA, AFDA)*	3.0	0.047	0.005	6.0	0.093	0.010	3.0	0.044	0.005	6.0	0.110	0.010	**18.0**	**4.5**	**0.071**	**0.007**
Published papers (full text) from domestic scientific conferences *(AFB, AFD, AFBB, AFDB)*	16.0	0.248	0.026	4.0	0.062	0.007	17.0	0.247	0.027	8.0	0.147	0.013	**45.0**	**11.3**	**0.179**	**0.018**

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

Research outputs: The typical way to quantitatively evaluate any institute is to summarise the scientometric parameters. The number of annual publications of the Institute averages around 53. Naturally this number fluctuates a little from year to year. In order to look at trends over time it is reasonable to divide the number of publications by the number of researchers. As can be seen from Table 2.1.8. the publication activity of the Institute is relatively stable (as regards the most common categories ADC and ADD). Also, the average IF of journals in which the Institute has published is rather stable (see table below; data are based on annual reports). The average median IF for all categories of journals in which the Institute published in the year 2015 was ca 1.6 (the median of median IFs for all such categories of journals in 2015 was also 1.6). From this point of view we can say that the quality of the outputs in 2015 was significantly above average (we could probably show very similar results also for other years).

On the critical side, the average number of WoS publications per FTE should be increased. It remains one of our primary goals to reach higher number of publications – although publication quality must not be sacrificed in pursuit of this. This situation is partially connected with entry into the projects of the EU Structural Funds. The majority of our researchers were participating in the writing of the project proposals and were subsequently fully involved in the project implementations and handling the administrative tasks imposed by the requirements of the VA agency. Another issue affecting progress towards this goal is diminishing number of applications for PhD study due to decreasing interest of students on chemistry and limited sources to offer the post doc position for successful graduates. Increased attention must be paid to this over the upcoming period.

	2012	2013	2014	2015
N_o of publications	56	61	45	55
Average IF	2.25	2.48	2.38	2.27

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

2.2.1. Table with citations per annum.

Citations of papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) have to be listed separately.

Citations, reviews	2011		2012		2013		2014		total		
	number	No. / FTE	number	No. / FTE	number	No. / FTE	number	No. / FTE	number	averaged number per year	av. No. / FTE
Citations in Web of Science Core Collection (1.1, 2.1)	1132.0	17.580	1329.0	20.675	1331.0	19.304	1308.0	24.013	**5100.0**	**1275.0**	**20.231**
Citations in SCOPUS (1.2, 2.2) if not listed above	102.0	1.584	99.0	1.540	114.0	1.653	73.0	1.340	**388.0**	**97.0**	**1.539**
Citations in other citation indexes and databases (not listed above) (3.2,4.2,9,10)	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	**0.0**	**0.0**	**0.000**
Other citations (not listed above) (3, 4, 3.1, 4.1)	1.0	0.016	2.0	0.031	0.0	0.000	0.0	0.000	**3.0**	**0.8**	**0.012**
Reviews (5,6)	0.0	0.000	0.0	0.000	0.0	0.000	0.0	0.000	**0.0**	**0.0**	**0.000**

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

[1] HELGAKER, Trygve - KLOPPER, Wim - KOCH, Henrik - NOGA, Jozef. Basis-set convergence of correlated calculations on water. In Journal of Chemical Physics, 1997, vol. 106, no. 23, p. 9639-9646. (3.516 - IF1996). (1997 - Current Contents, WOS, SCOPUS, WOS, SCOPUS). ISSN 0021-9606.
Citations: 420

[2] MADEJOVÁ, Jana. FTIR techniques in clay mineral studies. In Vibrational Spectroscopy, 2003, vol. 31, p. 1-10.
Citations: 264

[3] SCHLEYER, P.V. - JIAO, H.J. - HOMMES, N.J.R.V. - MALKIN, Vladimír G. - MALKINA, Olga L. An evaluation of the aromaticity of inorganic rings: Refined evidence from magnetic properties. In Journal of the American Chemical Society, 1997, vol. 119, no. 51, p. 12669-12670. ISSN 0002-7863.
Citations: 154

[4] MADEJOVÁ, Jana - KOMADEL, Peter. Baseline studies of The Clay Minerals Society Source Clays: Infrared methods. In Clays and Clay Minerals, 2001, vol. 49, no. 5, p. 410-432. (2001 - Current Contents). ISSN 0009-8604.
Citations: 145

[5] NOGA, Jozef - BARTLETT, Rodney J. The full CCSDT model for molecular electronic structure. In Journal of Chemical Physics, 1987, vol. 86, no. 12, p. 7041-7050. ISSN 0021-9606.
Citations: 113

[6] BARTLETT, Rodney J. - WATTS, J. D. - KUCHARSKI, Stanislaw A. - NOGA, Jozef. Non-iterative fifth-order triple and quadruple excitation energy corrections in correlated methods. In Chemical Physics Letters, 1990, vol. 165, no. 6, p. 513-522.
Citations: 104

[7] URBAN, Miroslav - NOGA, Jozef - COLE, S.J. - BARTLETT, Rodney J. Towards a full CCSDT model for electron correlation. In Journal of Chemical Physics, 1985, vol. 83, no. 8, p. 4041-4046. ISSN 0021-9606.
Citations: 73

[8] MADEJOVÁ, Jana - BUJDÁK, Juraj - JANEK, Marián - KOMADEL, Peter. Comparative FT-IR study of structural modifications during acid treatment of dioctahedral smectites and hectorite. In Spectrochimica Acta Part A - Molecular and Biomolecular Spectroscopy, 1988, vol. 54, no. 10, p. 1397-1406. ISSN 1386-1425.
Citations: 57

[9] BUJDÁK, Juraj. Effect of the layer charge of clay minerals on optical properties of organic dyes. A review. In Applied Clay Science, 2006, vol. 34, no. 1-4, p. 58-73. ISSN 0169-1317.
Citations: 46

[10] KOMADEL, Peter. Chemically modified smectites. In Clay Minerals, 2003, vol. 38, no. 1, p. 127-138. (0.966 - IF2002). (2003 - Current Contents). ISSN 0009-8558.
Citations: 46

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

J. Noga 1176

J. Madejová 1137

P. Komadel 907

V. Malkin 848

O. Malkina 791

J. Bujdák 628
P. Šajgalík 411

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

The total number of citations registered in WoS and SCOPUS remains between 1100 and 1300 citations per year. The quality of the outputs is also documented by the H-index of the Institute, which for the publications published 2012-2015 stands at 17. We consider this an outstanding result compared to other comparable institutions.

The Slovak Literary Foundation also confirmed our outstanding citation records by honouring 2 senior researchers of the Institute with the Premium of the Slovak Literary Foundation for a Scientific Echo (see chapter 2.3. - supplementary).

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

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

2.3.1. List of the most important research activities demonstrating the international relevance of the research performed by the institute, incl. major projects (details of projects should be supplied under Indicator 2.4). Max. 10 items.

– Participation in multilateral projects

- FP7-FUNEA: Functional nitrides for energy applications, Project No.: 264873, project coordinator: Technische Universtät Darmstadt, Germany, 6 countries involved, 9 participanting institutions, coordinator from IIC SAS: P. Šajgalík
  Funding: 35 689.00 €
- FP-7-pNMR: Pushing the envelope of nuclear magnetic resonance spectroscopy for paramagnetic systems. A combined experimental a theoretical approach (pNMR), Project No.: PITN-GA-2012-317127, project coordinator: Centre Europeen de RMN a Tres Hauts Champs, France, 9 countries involved, 12 participanting institutions, coordinator from IIC SAS: V. Malkin
  Funding: 19 179.00 €
- COST: Our Astro-Chemical History, Project No: CMST COST Action CM1401, project coordinator: Institut de Planétologie at dAstrophisique de Grenoble, France, 10 countries involved, 10 participanting institutions, coordinator from IIC SAS: J. Noga
  Funding: 4 600.00 €
- COST: New generation biomimetic and customized implants for bone engineering, Project No: MPNS COST Action MP1301, project coordinator: Belgium Ceramic Research Centre Mons, 56 institutions from more than 20 countries, coordinator from IIC SAS: P. Šajgalík
  Funding: 7 667.00 €
- ERANET: Graphene-ceramic composites for tribological application in aqueous environments. project coordinator: Fraunhofer-Gesellschaft, Institut für Werkstoffmechanik IWM, Germany, 3 countries involved, 6 participanting institutions, coordinator from IIC SAS: P. Šajgalík
  Funding: 9 300.00 €

- Horizon 2020: Building-up Centre of Excellence for advanced materials application — CEMEA, 664337 - H2020-WIDESPREAD-2014-1, project coordinator: Slovak Academy of Sciences Partners: Finland - Teknologian tutkimuskeskus VTT OyEspo, HELSINGIN YLIOPISTO, Slovakia - Institute of Physics (IP SAS), Institute of Electrical Engineering (IEE SAS), Institute of Inorganic Chemistry (IIC SAS), Polymer Institute (PI SAS), Institute of Materials and Machine Mechanics, Institute of Virology, Institute of Forecasting (IF SAS), Institute of Economic Research (IER SAS).

  Funding: 0 €

– Invited lectures of Institute employees at international conferences (79 lectures) and at foreign institutions within the assessment period (~60)
– Short-term and long-term research stays at institutions within projects, based on invitations or via fellowships: 37 short-term and 17 long-term stays (see 2.3. supplementary)
– International cooperation – the figure below shows the distribution of collaborations with academic (green circles) and industrial (blue circles) partners all around the world (the complete list is in section 4). This list details only cooperation resulting in joint publications, projects or extended research activities within 2012-2015. There are also a number of other institutions that we are in contact with but which produced no measurable outputs in this period.

– International awards (see 2.3. supplementary)
– Invitations of IIC SAS reserchers to participate as members of organizing committes or of advisory boards on international conferences

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

[1] **Workshop on Modern Methods in Quantum Chemistry**, Mariapfarr, Austria, 26.02.-02.03.**2012**
37 participants from 6 countries, 18 oral presentations, 15 posters.

[2] **Workshop on Modern Methods in Quantum Chemistry**, Mariapfarr, Austria, 24.02.-01.03.2013
45 participants from Finland, Norway, France, Germany, Slovakia, Czech Republic, New Zeland

[3] **Training Workshop: Electronic and nuclear relaxation, and structure calculation**, Mariapfarr, Austria, 22.02.-24.02.2014
38 participants: France, USA, Germany, Great Britain, Finland, Czech Republic, Sweden, Italy, France

[4] **7th Workshop on Modern Methods in Quantum Chemistry**, Mariapfarr, Austria, 23.02.-28.02.2014
53 participants: France, USA, Germany, Great Britain, Czech Republic, Sweden, Italy, Slovakia, France

[5] **11th Conference on Solid State Chemistry,** Trenčianske Teplice, Slovakia, 06.07.-11.07.2014
169 participants from 29 countries, 5 plenary, 71 oral presentations, 95 posters

[6] **11th International Conference on Relativistic Effects in Heavy-Element Chemistry and Physics (REHE-2014),** Smolenice, Slovakia, 20.09.-24.09.2014,
89 participants

[7] **Tableware glass melting and forming,** Trenčianske Teplice, Slovakia, 19.02.-20.02.2015
56 partcipants from 8 countries

[8] **8th Workshop on Modern Methods in Quantum Chemistry**, Mariapfarr, Austria, 22. - 27. 2. 2015
38 participants, 36 oral presentations: Germany, Czech Republic, Norway, Finland, Denmark, Slovakia

[9] **Engineering Ceramics 2015 – Materials for better life**, Smolenice, Slovakia, 10.05.-14.05.2015
86 participants from 15 countries, 22 invited lectures, 26 oral presentations

[10] **6th Japan-Czech-Slovak (JCS) International Symposium on Theoretical Chemistry**, Smolenice, Slovensko, 11.10.-15.10.2015
80 participants from Japan, Czech Republic, Slovakia, Norway

2.3.3. List of edited proceedings from international scientific conferences.

Book of abstracts, edited and issued by IIC SAS

[1] SSC 2014: 11th Conference on solid state chemistry, Trenčianske Teplice, Slovak Republic, 6-11 July 2014, book of abstracts, Ed. Jana Valúchová, Slovak Republic, 2014. 210 p, ISBN 978-80-971648-0-5.

[2] REHE-2014: book of abstracts of the 11th International conference on relativistic effects in heavy-element chemistry and physics, Smolenice castle, Slovakia, September 20-24, 2014, Bratislava: Institute of Inorganic Chemistry, Slovak Academy of Sciences, 2014, ISBN 978-80-971648-1-2.

[3] Advanced research workshop Engineering Ceramics 2015 - Materials for better life, Smolenice castle, May 10-14, 2015, Book of abstracts. Eds. Zoltán Lenčéš, Jana Valúchová, Bratislava, Slovakia, Institute of Inorganic Chemistry SAS, 2015, 94 p, ISBN 978-80-971648-3-6.

[4] JCS - 2015: 6th JCS international symposium on theoretical chemistry, Smolenice castle, Smolenice, October 11 - 15, 2015, Bratislava, Slovakia, Institute of Inorganic Chemistry, Slovak Academy of Sciences, 2015, USB key, ISBN 978-80-971648-4-3.

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

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

2.3.4.2. SCOPUS

2.3.4.3. other databases

2.3.4.4. not included in databases

- **National position of the institute**

2.3.5. List of selected projects of national importance

[1] Study on the feasibility of Slovak magnesite processing by means of exploitation of extraction and processing sewages, and of magnesium-rich metal wastes, in line with innovative trends

in the world, EU and Slovak Republic. 30/1020/2014-SPOL; project obtained from the Ministry of Education, Science, Research and Sport of the Slovak Republic.

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

General Calls – Research and development support in all scientific areas

Projects coordinated by IIC

[1] Development of composite biomaterials based on silicon nitride, BioNitrid APVV-0500-10, 2011-2014, prof. RNDr. Pavol Šajgalík, DrSc.

[2] Inorganic fluoride melts - the complex study of spectral, diffraction, physicochemical, thermodynamical and structural characteristics, ZrAlTa APVV-0460-10, 2011-2014, doc. Ing. M. Boča, PhD.

[3] Mechanisms of corrosion and micromechanical properties of dental materials. APVV-0218-11 KoroDENT, 2012-2015, doc. Ing. Dušan Galusek, PhD.

[4] Organoclays and their composites with polymers, OC&PCN APVV-0362-10, 2011-2014, RNDr. P. Komadel, DrSc.

[5] Photoactive hybrid nanomaterials with luminescent and antimicrobial properties. APVV-0291-11, HybridMater, 2012-2015, RNDr. Juraj Bujdák, DrSc.

[6] Relativistic calculations of parameters of NMR and EPR spectroscopy for compounds containing heavy elements: further methodological development and applications, ReSpect APVV-0483-10, 2011-2014, V.G. Malkin, DrSc.

[7] Structure and properties of oxide glasses for application in nuclear power technology, APVV-0487-11 SVOJE, 2012-2015, prof. Ing. Marek Liška, DrSc.

Projects sub-coordinated by IIC

[8] Development of Si_3N_4 with addition of grapheme platelets. APVV-0161-11 SiNGra, 2012-2015, prof. RNDr. Pavol Šajgalík, DrSc.

[9] Perlite genesis and innovative approaches to its exploitation and processing, APVV-0339-12 PERLIT, 2013-2017, RNDr. Jana Madejová, DrSc.

[10] Polyapplicable heterocycles - design, synthesis and properties. PAPHET, 2012-2015, RNDr. Ľubomír Smrčok, CSc.

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

Selected projects (from the total of 20 during the assessed period).

[1] Ceramic coatings with glass fillers for high temperature corrosion protection of metals, VEGA 2/0058/14, 01/2014-12/2016, prof. Ing. Dušan Galusek, PhD.

[2] Hybrid materials based on layered silicates with cyanine and porphyrine dyes VEGA 2/0107/13, 2013 - 2017, Mgr. A. Czímerová, PhD.

[3] Improvement of functional properties of ceramic materials with the addition of carbon nano-tubes and graphene, VEGA 2/0065/14, 2014-2017, doc. Ing. Miroslav Hnatko, PhD

[4] Low melting electrolytes and wetted cathodes with potential for electrolytic aluminium production, VEGA 2/0116/14, 2014-2017, Ing. F. Šimko, PhD.

[5] Molten fluoride systems for high temperature applications with potential in energy sector application, VEGA 2/0095/12, 2012-2015, doc. Ing. M. Boča, PhD.

[6] Preparation and properties of novel organoclays for polymer and environmental applications VEGA 2/0132/13, 2013 - 2016, RNDr. J. Madejová, DrSc.

[7] ReSpect - a practical and efficient computational tool to study heavy element compounds VEGA 2/0148/13, 2013 - 2016, Dr. O. Malkina, DrSc.

[8] Study of the mechanism of corrosion of materials used in a melting of industrially produced glasses. VEGA 2/0165/12, 2012-2015, doc. Ing. P. Šimurka, PhD.

[9] Structure and dynamics of hydrogen bonds in solids by diffraction methods, quantum chemistry and inelastic neutron spectroscopy (INS). VEGA 2/0131/12, 2012-2015, RNDr. Ľ. Smrčok, CSc.

[10] Ternary silicon nitride and oxynitride-based phosphors, VEGA 2/0112/14, 2014-2017, doc. Ing. Zoltán Lenčéš, PhD

2.3.8. Projects of SAS Centres of Excellence

[1] Center of Excellence for Functionalized Multiphase Materials, co-ordinator: Institute of Physics (RNDr. Marián Krajči, DrSc.), 08/2011 - 08/2015, coordinator IIC SAS: prof. RNDr. Pavol Šajgalík, DrSc., Partners: Faculty of Mathematics, Physics and Informatics Comenius University, Bratislava, Institute of Materials & Machine Mechanics SAS, Institute of Polymers SAS, Faulty of Materials Science and Technology in Trnava,

2.3.9. National projects supported by EU Structural Funds

[1] MACHINA II - Centre for Materials, Layers and Systems for the Applications and Chemical Processes in the Extreme Environments – Stage II. ITMS 26240120021

[2] CEKSIM - Center of Excellence for Ceramics, Glass and Silicate Materials. ITMS 262 201 20056

[3] Centre of Knowledge Commercialization and Intellectual Property Rights Management of the Slovak Academy of Sciences. ITMS 26240220006

[4] PLASMAT - High-flow Plasma Generator Based on Composite Materials for Gasification of Solid Hydrocarbons. ITMS 26240220054

[5] PVTECHSKLO - Industrial Research for Needs of the Reengineering of the Unique Technology of the Glass Preparation and the Forming Work. ITMS 26220220072

[6] ZDESJE - Knowledge Database and Expert System for Environmental Friendly Solutions of Loss of Coolant Accidents in Atomic Nuclear Power Plants. ITMS 26220220084

[7] Applied Research of Technology of Thermal Plasma Processes. ITMS 26240220070

[8] ENERGOZ - Effective Control of Production and Consumption of Energy from Renewable Sources. ITMS 26240220028

[9] Competence Center for new Materials, Advanced Technologies and Energy. ITMS 26240220073

[10] University Science Park of STU Bratislava, ITMS 26240220084

[11] Center for applied research of new materials and technology transfer, ITMS 26240220088

[12] Investigation and verification of catalytic dehalogenation on reactive barriers technologies - treatment of contaminated water from polluted industrial sites, ITMS 26240220078

[13] Research centre ALLEGRO, ITMS 26220220198,

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

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

2.3.10.2. SCOPUS

2.3.10.3. Other databases

2.3.10.4. Not included in databases

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

2.3.11. List of invited/keynote presentations at international conferences, as documented by programme or invitation letter - zoznam pozvaných prednášok zo správ

P. Boháč - A. Czímerová - S. Belušáková - J. Bujdák, Layer-by-Layer prepared hybrid systems based on clay minerals and organic dyes, Seminar - Clay minerals, organised by VŠB TU Ostrava and Czech Clay Group, Ostrava, Czech Republic, 26. 11. 2015.

D. Galusek, Ceramic nanocopomposites with alumina matrix, EMN Meeting on Ceramics, Double Tree by Hilton Orlando at SeaWorld, Orlando, USA, 26. - 29. 01. 2015.

P. Gaalová - A. Švančarková - J. Balko - D. Galusková - F. Lofaj - **D. Galusek**, Corrosion in acidic media, micromechanical properties and wear of human tooth enamel, 14th International Conference of the European Ceramic Society, Toledo, Spain, 21. - 25. 06. 2015.

K. Bodišová - V. Pouchlý - K. Maca - **D. Galusek**, Two-stage sintering, doping, and microstructure refinement of polycrystalline alumina, The first Polish-Korean Workshop on Advanced Ceramics, Zakopane, Poland, 19. 09. 2015.

R. Klement - A. Prnová - S.-J. Shih - W.-H. Tuan, **D. Galusek,** Aluminate and aluminosilicate glass phosphors with rare earth and transient element activators, International Symposium on Advanced Ceramics and Technology for Sustainable Energy Applications, ACTSEA 2015, National Cheng Kung University, Tainan, Taiwan, 08. - 11. 11. 2015.

P. Komadel, Clays and clay minerals, Workshop NOVACEM - Increasing environmental protection by innovative advanced technologies of cement production of newe generation, Chorvátsky Grob - Čierna Voda, Slovakia, 5. - 6. 5. 2015

Z. Lenčéš - M. Hrabalová - I. Ibrahim - Ľ. Benco - P. Šajgalík, Influence of lanthanoid dopant and N/O substitution on the electronic structure and luminescent properties of silicon oxynitride phosphors, ICACC 2015 - 39th International conference and exposition on advanced ceramics and composites, Daytona Beach, Florida, USA, 25. - 30. 01. 2015.

Z. Lenčéš - I. Ibrahim - Ľ. Benco - P. Šajgalík, Influence of rare-earth dopant and N/O substitution on the electronic structure and luminescent properties of silicon oxynitride phosphors, 11th International Conference on Ceramic Materials and Components for Energy and Environmental Applications, Vancouver, Canada, 14. - 19. 6. 2015.

Z. Lenčéš - I. Ibrahim - Ľ. Benco - P. Šajgalík, Electronic Structure and Luminescent Properties of Rare-Earth Oxide Doped Silicon Oxynitride Phosphors, 11th Pacific Rim Conference of Ceramic Societies, PACRIM 11, Jeju, Korea, 30. 08. - 04. 09. 2015.

J. Madejová, Various benefits of IR spectroscopy in clay minerals studies, Workshop NOVACEM - Increasing environmental protection by innovative advanced technologies of cement production of newe generation, Chorvátsky Grob - Čierna Voda, Slovakia, 5. - 6. 5. 2015

V. Malkin, Calculations of the EPR g-tensor in the framework of 2- and 4-component DFT and HF

approaches. In Open Shells. Open Questions, Huset, Middelfart, Denmark, 24-26 August 2015.

V. Malkin, Introduction to calculation of NMR and EPR parameters (part 1), EU CECAM Workshop deMon2K and deMonNano tutorial, Orsay, France, 14. – 21. 06. 2015.

O. Malkin, Introduction to calculation of NMR and EPR parameters (part 2), EU CECAM Workshop deMon2K and deMonNano tutorial, Orsay, France, 14. – 21. 06. 2015.

J. Noga, Use of the helical-screw symmetry in the calculation of nanotubes: application to structural aspects and stability of superconducting nanotubular MgB_2. Frontiers of Electronic Structure Theory 2015 (FEST 15), Goa, India, 26. - 28. 5. 2015.

J. Noga, Optimized Thouless Expansion as an Alternative to Orbital Optimization Schemes. 15th International Congress of Quantum Chemistry, Beijing, China, 06. - 13. 6. 2015.

J. Noga, Exponential cluster expansion as a universal wave function ansatz, Miniconference on the occasion of Joe Paldus' 80th birthday, Praha, Czech Republic, 27. 11. 2015.

L. Petra - C. Breen - F. Clegg - P. Komadel, Preparation and characterisation of carbon-clay composites. Seminar - Clay minerals, organised by VŠB TU Ostrava and Czech Clay Group, Ostrava, Czech Republic, 26. 11. 2015.

P. Šajgalík - M. Hnatko - Z. Lenčéš - M. Gall - J. Dusza - P. Tatarko - Z. Chlup, GB chemistry of silicon nitride based nano-composites - implications for mechanical, tribological and chemical properties, ICACC 2015 - 39th international conference and exposition on advanced ceramics and composites, Daytona Beach, Florida, USA, 25. - 30. 01. 2015.

P. Šajgalík - J. Sedláček - Z. Lenčéš - J. Dusza - H.-T. Lin, Additive-free hot-pressed silicon carbide ceramics - a material with exceptional mechanical properties. ICACC 2015 - 39th international conference and exposition on advanced ceramics and composites, Daytona Beach, Florida, USA, 25. - 30. 01. 2015.

P. Šajgalík - M. Hnatko - Z. Lenčéš - M. Gall - J. Dusza - P. Tatarko - Z. Chlup, Chemical composition of GB in Si_3N_4 - simulation and experiment, International workshop on Sintering and microstructural evolution in ceramics, KAIST, Daejeon, Korea, 27. - 29. 08. 2015.

P. Šajgalík - J. Sedláček - Z. Lenčéš - J. Dusza - H.-T. Lin, Additive-free hot-pressed silicon carbide ceramics - a material with exceptional mechanical properties, ACTSEA 2015 - 5th international symposium on advanced ceramics and technology for sustainable energy applications, Tainan, Taiwan, 08. - 11. 11. 2015.

P. Šajgalík Energy efficient processing of additive-free hot-pressed silicon carbide ceramics; 11th International Conference on Ceramic Materials and Components for Energy and Environmental Applications, Vancouver, Canada, 14. - 19. 06. 2015.

P. Šajgalík Thermal shock resistance, wear behaviour and oxidation resistance of silicon nitride based nano-composites; 11th International Conference on Ceramic Materials and Components for Energy and Environmental Applications, Vancouver, Canada, 14. - 19. 06. 2015.

P. Šajgalík Slide and abrasive wear of graphite/silicon nitride based composites; 11th International Conference on Ceramic Materials and Components for Energy and Environmental Applications, Vancouver, Canada, 14. - 19. 06. 2015.

P. Šajgalík - M. Hnatko - Z. Lenčéš - M. Gall - J. Dusza - P. Tatarko - Z. Chlup, Role of GB chemistry of silicon nitride based ceramics with respect to the mechanical properties – experimental and theoretical approach; 14th International Conference of the European Ceramic Society, 2015, Toledo, Spain, KEYNOTE LECTURE, 21. - 25. 06. 2015.

P. Šajgalík, Functionalization of nitride engineering ceramics by polymer derived ceramic method; GZ 1145 German-Chinese Workshop „Preparation and Application of Ultra-high Temperature Ceramic Matrix Composites“, Darmstadt, Germany, 26. - 31. 07. 2015.

P. Šajgalík - Z. Lenčéš - R. RiedeL - H.- J. Kleebe. Functionalization of silicon nitride engineering ceramics by polymer-derived sintering aids. In the 90th DKG annual meeting in conjunction with the symposium on high-performance ceramics, Bayreuth, Germany, 15. - 17. 03. 2015.

P. Šajgalík - J. Sedláček - Z. Lenčéš - J. Dusza - H.-T. Lin, Dense Additive-Free Hot-Pressed Silicon Carbide Ceramics, 11th Pacific Rim Conference of Ceramic Societies, PACRIM 11, Jeju, Korea, 30. 08. - 04. 09. 2015

T. Bučko, S. Lebegue, J. G. Angyan, and J. Hafner: Density dependent correction for the description of London dispersion forces: improved Tkatchenko-Scheffler method and its applications, Solid State Chemistry 2014, Trenčianske Teplice, Slovakia, 8. 7. 2014.

J. Bujdák: Hybrids based on organic dyes and smectites - fundamentals and potential applications, MECC 2014 - 7th Mid-european Clay Conference, Dresden, Germany, 18. 9. 2014.

M. Liška - M. Chromčíková - J. Macháček - B. Hruška - V. Zemanová - T. Gavenda: Thermodymanic modell of ZnO-MoO3-P_2O_5 glasses and its validation by MCR analysis of Raman spectra of ZnO-P_2O_5, International Days of Materials Science 2014, Pardubice, Czech Republic, 16. - 17. 9. 2014.

M. Liška - V. Soltesz - M. Chromčíková - J. Vokelová: Glass-fiber insulation and nuclear plant safety, Czech and Slovak Conference on Glass, Žďár nad Sázavou, Czech Republic, 5. - 7. 11. 2014.

Z. Lenčéš - M. Hrabalová - I. Ibrahim - Ľ. Benco - P. Šajgalík, Influence of lanthanoid dopant and N/O substitution on the electronic structure and luminescent properties of silicon oxynitrid phosphors. ISNT 2014 8th International Symposium on Nitrides, 7th International Workshop on Spinel Nitrides and Related Materials, Marie Curie ITN 7th FP FUNEA, Wildbad Kreuth, Germany, 31. 8. – 5. 9. 2014.

Z. Lenčéš - M. Hrabalová - I. Ibrahim - Ľ. Benco - P. Šajgalík, Theoretical and experimental approach to ternary silicon oxynitride-based phosphors. 5th International Congress on Ceramics (ICC-5), Beijing, China, 17. – 21. 8. 2014.

H. Pálková: InfraRed Spectroscopy – a versatile tool in qualitative analysis of materials, Workshop Analytical methods in the service of conservation and restoration work, VŠB, Centrum of Nanotechnology, Czech Republic, 6. 11. 2014.

P. Šajgalík - M. Hnatko - Z. Lenčéš - M. Gall - Z. Chloup: GB chemistry of silicon nitride based nanocomposites - implications for fracturing behavior - experimental and theoretical study, ICACC 2014 - 38th International Conference and Exposition on Advanced Ceramics and Composites, Daytona Beach, Florida, USA, 26. – 31. 1. 2014.

P. Šajgalík - M. Hnatko - Z. Lenčéš - A. Kovalčíková: Easy machinable SiC ceramics with high electrical conductivity. ISSNOX4 4th international symposium on SiAlONs and non-oxides, Shiga, Japan, 25. – 28. 2014.

P. Šajgalík - J. Sedláček - Z. Lenčéš - J. Dusza - H.-T. Lin: Additive-free hot-pressed silicon carbide ceramics - a material with exceptional mechanical properties. ISNT 2014 8th International Symposium on Nitrides, 7th International Workshop on Spinel Nitrides and Related Materials, Marie Curie ITN 7th FP FUNEA, Wildbad Kreuth, Germany, 31. 8. – 5. 9. 2014.

P. Šajgalík: From knowledge to product – Austrian industry – Slovak academia collaboration, 10. 04. 2014; iconvienna 2014, The 10th European Business and Investment Forum, East – West Summit on Innovation and Smart Cities, Vienna, Austria, 9. – 11. 4. 2014.

P. Šajgalík: Science in education, education in science – necessity or contradiction? 15. 05. 2014; International Conference on the Quality of Language Education, Comenius University, Bratislava, Slovakia 15. – 16. 05. 2014.

P. Šajgalík: Slovak Academy of Sciences – Promoting the excellence – the bottom-up perspective,

10 years of the V4 in European research: experience and future, Permanent Representation of Hungary to the EU, Brussels, Belgium, 1. 7. 2014.

T. Bučko - S. Lebegue - J. Hafner - J. G. Angyan: Improved density dependent correction for the description of London dispersion interactions, 5th JCS International Symposium on Theoretical Chemistry, Nara, Japan, 2. – 5. 12. 2013.

A. Czímerová: Traditional and novel methods for the characterization of the layer charge of clay minerals, 2nd International Conference Clays, Clay Minerals and Layered Materials, St. Petersburg State University, Faculty of Geology, St.Petersburg, Russia, 08.09.2013 – 11. 09. 2013.

P. Komadel - M. Pentrák - J. Madejová - V. Hronský - P. Uhlík: Smectites in contact with acids. 2nd International Conference "Clays, Clay Minerals and Layered Materials", Saint Petersburg, Russia, 11. – 15. 9. 2013.

Z. Lenčéš - M. Hrabalová - I. Ibrahim - L. Benco - P. Šajgalík: Europium and cerium-doped $MgSiN_2$ and $LaSi_3N_5$ – electronic structure and luminescent properties, 13th International Conference of the European Ceramic Society, Limoges, France, 21. – 27. 6. 2013.

Z. Lenčéš - L. Benco - M. Hrabalová - I. Ibrahim - P. Šajgalík: Functionalization of silicon nitride/oxynitride-based engineering ceramics, Spring Meeting of the European Materials Research Society (E-MRS), Strasbourg, France, 27. – 29. 2013.

Z. Lenčéš, P. Šajgalík, M. Hnatko, M. Gall, P. Tatarko, Z. Chlup: Grain boundary chemistry of silicon nitride based nano composites – Implications to mechanical, tribological and chemical properties, Innovative Manufacturing Technology (IMT 2013), Krakow, Poland, 18. – 20. 11. 2013.

Z. Lenčéš - M. Hrabalová - I. Ibrahim - L. Benco - P. Šajgalík: Influence of Eu, Ce and Sm Dopants on the Electronic Structure and Photoluminescence of $MgSiN_2$ and $LaSi_3N_5$-Based Phosphors, 4th International Symposium on Advanced Ceramics and Technology (ACTSEA 2013) Taipei, Taiwan, 09. – 15. 11. 2013.

M. Liška - M. Chromčíková - H Kaňková - P. Vlčková - K Faturíková - V. Soltesz: Kinetics and thermodynamics of glass fibrous insulation corrosion by the coolant solution – building a kinetic model from experimental data, 23rd International Congress on Glass, Praha, Czech Republic, 24. – 25. 9. 2013.

M. Liška - M. Chromčíková - J. Macháček: Glass structure and thermodynamic models, International Days of Materials Science, Pardubice, Czech Republic, 24. – 25. 9. 2013.

J. Madejová: Near-IR spectroscopy in the organo-clays studies, Nano Ostrava 2013, Czech Republic, 17. – 20. 6. 2013.

J. Madejová: InfraRed spectroscopy: Theory and clay minerals applications, Second Russian School by Clay Minerals-Argilla studium 2013, St. Petersburg, Russia, 8 – 11. 9. 2013.

O. Malkin - A. Křístková: Relativistic 4-component calculations of indirect nuclear spin-spin couplings. To fit, or not to fit: that is the question, deMon developers meeting, Toulouse, France, 24. – 27. 6. 2013.

A. Křístková - S. Komorovský - M. Repiský - V. Malkin - **O. Malkin**: Recent progress in relativistic four-component calculations in NMR indirect nuclear spin-spin coupling constants, the 5th Japanese-Czech-Slovak International Symposium on Theoretical Chemistry, Nara, Japan, 2. – 6. 12. 2013.

V. Malkin: Relativistic calculations of NMR and EPR parameters: current situation and outlook, pNMR kick-off meeting (v rámci medzinárodného projektu: pNMR FP7-PEOPLE-2012-ITN), Lyon, France,10. – 11. 2. 2013.

V. Malkin: Fully relativistic calculations of EPR and NMR parameters: do we understand what we are doing?, deMon developers meeting, Toulouse, France, 24. – 27. 6. 2013.

V. Malkin: Fully relativistic calculations of pNMR parameters: development, interpretation and applications, pNMR conference, Chamonix, France, 6. – 8. 9. 2013.

V. Malkin: Four-Component Relativistic Density Functional Theory Calculations of NMR Shielding Tensors for Paramagnetic Systems, The 5th Japanese-Czech-Slovak International Symposium on Theoretical Chemistry, Nara, Japan, 2. – 6. 12. 2013.

J. Noga: Ab initio theory in a nutshell, Molecular processes for astrochemistry, COST 'The Chemical Cosmos' training school, 2 x 60 min., Grenoble, France, 18. – 22. 3. 2013.

J. Noga: From XCC to XGCC, 7th Molecular Quantum Mechanics, International Conference on Electron Correlation: The Many-Body Problem at the Heart of Chemistry, Palazzo dei Congressi, Lugano, France, 2. – 7. 6. 2013.

J. Noga: Expectation value coupled cluster approach using the ansatz with generalized double-substitutions cluster operator, The VIIIth Congress of the International Society of Theoretical Chemical Physics, Budapest, Hungary, 25. – 30. 8. 2013.

O. Demel - S. Kedžuch - **J. Noga** - J. Pittner: State-specific explicitly correlated multi-reference coupled cluster method including perturbative triple-excitations correction, 9th European Conference of Computational Chemistry, Sopron, Hungary, 1. – 5. 9. 2013.

P. Šajgalík - Z. Lenčéš - M. Hnatko - T. Plachký - R. Riedel: Functionalization of nitride engineering ceramics by polymer derived sintering aids, 37th International Conference and Expo on Advanced Ceramics and Composites, Daytona Beach USA, 29. 1. 2013.

P. Šajgalík - Z. Lenčéš - M. Hnatko - T. Plachký - R. Riedel: Functionalization of nitride engineering ceramics by polymer derived sintering aids, PacRim10, SanDiego, USA, 2. – 7. 6. 2013.

P. Šajgalík - Z. Lenčéš - F. Frajkorová: Easy machinable SiC ceramics, PacRim10, SanDiego, USA, 2. - 7. 6. 2013.

P. Šajgalík: SiC/Si_3N_4 nano/micro-composites – phase and chemical composition - their implications for RT and HT mechanical properties, 13th International Conference of the European Ceramic Society, Limoges, France, 23. – 27. 6. 2013.

P. Šajgalík: SiC/Si_3N_4 nano/micro-composites – phase and chemical composition - their implications to the RT and HT mechanical properties, International Conference of the Polish Ceramic Society, Zakopane, Poland, 19. – 22. 9. 2013.

P. Šajgalík - Z. Lenčéš - M. Michálková - Y. Zhou - K. Hirao: Ternary Silicon Nitrides - from Engineering to Phosphors, ACTSEA2013 Taipei, Taiwan, 11. 11. 2013.

P. Šajgalík: GB chemistry of silicon nitride based nano-composites – implications to mechanical, tribological and chemical properties, 5th ISAC and 3rd ASPT, Wuhan, China, 11. 12. 2013.

O. Hanzel - Z. Lenčéš - J. Sedláček - M. Hnatko - Š. Kavecký - **P. Šajgalík**: Processing and properties of Al_2O_3-CNT and SiC-CNT nanocomposites, 6th International Conference on Noscience, Nanotechnologies, Nanomaterials and NANO INFO DAY of the Nanoforce Project - NANOVED, Svit, Slovakia, 22. – 25. 9. 2013.

M. Boča - P. Barborík - M. Micušík - M. Omastová: X-ray photoelectron spectroscopy as a tool for identification of fluorine atoms with different bonding properties, ESAS 2012 - XXth SCSC. European symposium on atomic spectrometry 2012 and XXth Slovak-Czech Spectroscopic Conference, Tatranská Lomnica, Slovakia, 7. – 12. 10. 2012.

D. Galusek - R. Klement - A. Prnová: Aluminate Glass and Glass Ceramic Phosphors, 10th International Symposium on Ceramic Materials and Components for Energy and Environmental Applications, Dresden, Germany, 20. – 23. 5. 2012.

D. Galusková - D. Galusek: Research and projects at the Center of Excellence for Ceramics,

Glass and Silicate Materials, Examples of good practice in developing partnership networks between R&D institution and industry, Brno, Czech Republic, 18. – 19. 9. 2012.

D. Galusková - M. Kašiarová - M. Hnatko - D. Galusek - P. Šajgalík - J. Dusza: Influence of corrosion on the surface characteristics and mechanical properties of structural ceramics, Potential and Applications of Surface Nanotreatment of Polymers and Glass, Brno, Czech Republic, 15. – 17. 10. 2012.

M. Liška - M. Chromčíková - J. Holubová - K. Faturíková: Glass structure study by Raman spectroscopy combined with thermodynamic modeling, European symposium on atomic spectrometry 2012 and XXth Slovak-Czech spectroscopic conference, Tatranská Lomnica, Slovakia, 7. – 12. 10. 2012.

O. Malkin: NMR spin-spin couplings through a hydrogen bond and overlap of densities of localized molecular orbitals*,* 2nd YIM EAST-NMR-2012 conference, Bratislava, Slovakia, 16. – 18. 5. 2012**.**

V. Malkin: Second-order spin-orbit contributions to EPR parameters: obstacles for theoretical methods and experimental studies*,* 10th International Conference on Relativistic Effects in Heavy-Element Chemistry and Physics (REHE-2012) Corrientes, Argentina, 11. – 17. 9. 2012.

P. Šajgalík - M. Hnatko - Z. Lenčéš - F. Frajkorová - E. A. Bolaños: Electrically Conductive SiC Ceramics, ISASC 2012 **-** International Symposium on New Frontier of Advanced Si-Based Ceramics and Composites, Seoul, South Korea, 25. – 28. 5. 2012.

P. Šajgalík - Š. Lojanová - M. Hnatko - Z. Lenčéš - M. Gall - Z. Chlup: GB chemistry of SiC/Si_3N_4 nano/micro-composites – implications to fracture behavior - experimental and theoretical study**,** CMCEE, Dresden, Germany, 21. 5. 2012.

P. Šajgalík - Z. Lenčéš - T. Plachký - R. Riedel - H.J. Kleebe: Functionalization of nitride engineering ceramics by polymer derived sintering aids, 7th International Symposium on Nitrides, Saint Malo, France, 3. – 6. 6. 2012.

P. Šajgalík - Z. Lenčéš - L. Benco - D. Velič - Y. Zhou - K. Hirao: Ternary Silicon Nitrides – from Engineering to Phosphors,Bi-Annual meeting of the World Academy of Ceramics, WAC, Perugia, Italy, 29. 6. – 3. 7. 2012.

P. Šajgalík: Si_3N_4 + SiC nanoceramics with excellent room- and high-temperature properties, MRS 2012, Warsaw, Poland, 17. 9. 2012.

P. Šimurka - R. Klement - J. Sedláček - J. Kraxner: Corrosion of refractories used in a melting of industrially produced tableware glass, 11th European Society on Glass Conference, Maastricht, Netherlands, 3. – 6. 6. 2012.

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

M. Boča

- Research and development in the area of chemistry and technology of functional materials Apatity, Russia, 2015, org. committee
- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014, chair
- NANO OSTRAVA, Ostrava, Czech Republic, 2013, prog. committee

J. Bujdák

- NanoOstrava 2015 – 4th Nanomaterials and Nanotechnology Meeting, Ostrava, Czech Republic, 2015, advisory board

M. Drábik

- XXV. International Conference on Coordination and Bioinorganic Chemistry, Smolenice, Slovensko, 2015, org. committee

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014
- 24. ICCBiC, SMolenice, Slovakia, 2013

D. Galusek

- Engineering Ceramics 2015 – Materials for better life, Smolenice, Slovakia, org. committee, 2015
- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014

P. Komadel

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014
- EUROFILLERS 2013, Bratislava, 2013, prog. committee

M. Korenko

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014

B. Kubíková

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014

Z. Lenčéš

- Engineering Ceramics 2015 – Materials for better life, Smolenice, Slovakia, org. committee, 2015
- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014
- 5th International Congress on Ceramics (ICC-5), Beijing, China, 2014
- 13th International Conference of the European Ceramic Society, Limoges, France, 2013

M. Liška

- The 23rd International Congress on Glass, 1.-5.7.2013, Prague, Czech Republic, prog. com

J. Madejová

- MECC 2012, Průhonice u Prahy, Czech Republic, prog. comm

O. Malkin

- 6th JCS International Symposium on Theoretical Chemistry, Smolenice, Slovakia, 2015, co-chair
- 8th Workshop on Modern Methods in Quantum Chemistry, Mariapfarr, Austria, 2015, prog/org. com.
- 11th International Conference on Relativistic Effects in Heavy-Element Chemistry and Physics (REHE-2014), Smolenice, Slovakia, 2014, prog/org. com.
- 7th Workshop on Modern Methods in Quantum Chemistry, Mariapfarr, Austria, 2014
- Training Workshop: Electronic and nuclear relaxation, and structure calculation, Mariapfarr, Austria, 2014, prog. org.

V. Malkin

- 6th JCS International Symposium on Theoretical Chemistry, Smolenice, Slovakia, 2015, co-chair
- 8th Workshop on Modern Methods in Quantum Chemistry, Mariapfarr, Austria, 2015, prog/org. com.
- 11th International Conference on Relativistic Effects in Heavy-Element Chemistry and Physics (REHE-2014), Smolenice, Slovakia, 2014, prog/org. com.
- 7th Workshop on Modern Methods in Quantum Chemistry, Mariapfarr, Austria, 2014
- Training Workshop: Electronic and nuclear relaxation, and structure calculation, Mariapfarr, Austria, 2014, prog. org.
- Workshop on Modern Methods in Quantum Chemistry, Mariapfarr, Austria, 2013
- Workshop on Modern Methods in Quantum Chemistry, Mariapfarr, Austria, 2012

M. Michálková

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014

J. Noga

- The VIIIth Congres of the International Society of Theoretical Chemical Physics, Budapest, Hungary, 2013, prog

H. Pálková

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014

E. Scholtzová

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014

P. Šajgalík

- 11th International Conference on Ceramic Materials and Components for Energy and Environmental Applications, Vancouver, Canada, 2015
- 11th Pacific Rim Conference of Ceramics Societies, Jeju, Korea, Advisory board, 2015
- 14th International Conference of the European Ceramic Society, Toledo, Spain
- Engineering Ceramics 2015 – Materials for better life, Smolenice Slovakia, 2015
- International Conference & Exposition on Advanced Ceramics & Composites, Daytona Beach, Florida, USA - org. com
- International Symposium on Advanced Ceramics and Technology for Sustainable Energy Applications, Tainan, Taiwan, 2015
- Symposium: 2nd European Union - USA Engineering Ceramics Summit, Daytona Beach, Florida, USA, 2015
- 2nd V4-JST Workshop on Advanced Materials, Warsaw, Poland, 2014, prog
- 38th International Conference and Exposition on Advanced Ceramics and Composites, Daytona Beach, Florida, USA, 2014, org
- 4th International Symposium on SiAlONs and Non-oxides (ISNOX 2014), Shiga, Japan
- 8th International Symposium on Nitrides (ISNT 2014), Wildbad Kreuth, Germany
- 13th International Conference of the European Ceramic Society, Limoges, Francúzsko, 2013
- 4th International Symposium on Advanced Ceramics and Technology (ACTSEA 2013), Taipei, Taiwan, 2013
- 5th ISAC and 3rd ASPT, Wuhan, Čína, 2013

P. Šimurka

- ICG Annual meeting, Bangkok, Thailand, 2015, advisory
- Tableware glass melting and forming, Trenčianske Teplice, Slovakia, 2015
- The 23rd International Congress on Glass, 1.-5.7.2013, Prague, Czech Republic, 2013

J. Valúchová

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014

Z. Vasková

- 11th Conference on Solid State Chemistry, Trenčianske Teplice, Slovakia, 2014

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

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

M. Chromčíková - M.Liška, Application of thermophysical methods for oxide/silicate glasses, Thermophysics and Mass Transfer in Materials Science and Construction, Terchová, 99-104, 2015

P. Komadel, Materials research at the IIC SAS, 50th anniversary of foundation of Faculty of inorganic chemistry, University of P. J. Šafárika, Košice, 15. - 17. 06. 2015

V. Pavlik, The way to the innovation of advanced materials, workshop Application of materials in practice, Technical University Brno, Czech Republic, 20. 11. 2015

J. Bujdák: Fotosenzitization materials for oxygen activation, basics of antimicrobial properties and

potential applications. What is New in Microbiology. Conference for young microbiologists, Jasná, 21. – 24. March 2013

J. Bujdák: Seminar about International Clay Conference in Washington in 2012 D.C., USA. Lecture for the students at the Slovak national competition of Chemical Olympiad (organized by IUVENTA), Bratislava, 25. February, 2013.

M. Drábik: Simultaneous thermal analysis, thermoanalytical characteristics and stoichiometry of thermal decompositions of inorganic materials and substances. Workshop T. A. Instruments, Institute of Physics SAS, Bratislava, Slovakia 19. 9. 2013.

J. Madejová - V. Hronský - H. Pálková - Ľ. Jankovič: IR and NMR study of acid-treated organo-montmorillonites, Physics of Materials 2012, Technical University, Košice, 17 – 19. 10. 2012

M. Pentrák - J. Madejová - V. Hronský - P. Uhlík - **P. Komadel**: Characterization and acid dissolution of a fine fraction of a bentonite, Physics of Materials 2012, Technical University, Košice, 17 – 19. 10. 2012

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

M. Boča

- The interaction of the molten salts with the progressive inorganic materials, Borinka, Slovakia, 2014

M. Dárbik

- 67th Chemists Congress (67. Zjazd chemikov), Starý Smokovec, Slovakia, 2015
- 65th Chemists Congress (65. zjazd chemikov), Tatranské Matliare, Slovakia, 2013

M. Hnatko

- The interaction of the molten salts with the progressive inorganic materials, Borinka, Slovakia, 2014

P. Komadel

- Clay minerals and selected raw materials in material science and industrial applications (Ílové minerály a vybrané nerudné suroviny v materiálovom výskume a priemyselných aplikáciách), Stará Lesná, Slovakia, 2013

J. Madejová

- Clay minerals and selected raw materials in material science, industrial applications and environment protection (Ílové minerály a vybrané nerudné suroviny v materiálovom výskume, priemyselných aplikáciách a životnom prostredí), Smolenice, Slovakia, 2015
- Clay minerals and selected raw materials in material science and industrial applications (Ílové minerály a vybrané nerudné suroviny v materiálovom výskume a priemyselných aplikáciách), Stará Lesná, Slovakia, 2013

V. Bizovská

- Clay minerals and selected raw materials in material science, industrial applications and environment protection (Ílové minerály a vybrané nerudné suroviny v materiálovom výskume, priemyselných aplikáciách a životnom prostredí), Smolenice, Slovakia, 2015

P. Šajgalík

- The interaction of the molten salts with the progressive inorganic materials, Borinka, Slovakia, 2014

P. Šimurka

- Czech and Slovak conference on glass (Česká a slovenská konferencia o skle), Žďár nad Sázavou, Czech Republic, 5.-7.11.2014

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

i. AWARDS AND HONOURS

Team awards - international

2012 - Bronze medal for the „Laboratory hot press ONE“ presented at the prestigious Taipei International Invention Show and Technomart, INST 2012 (20. - 23. 9. 2012, Taipei, Taiwan) organised by the Taiwan External Trade Development Council (TAITRA).

Conferred by: International committee of experts in intellectual property from relevant research, technology and patent institutions (Taiwan, Japan, Great Britain, France).

Description: Laboratory Hot Press ONE! allows preparation of dense ceramics and other materials by sintering of powders under simultaneous application of high temperature (up to 2100 °C) and axial pressure (up to 40 MPa) in an inert atmosphere or vacuum at the Department of Ceramics.

Team awards - domestic

2014 - Prize of the Slovak Academy of Sciences for infrastructure development

- Conferred by: presidium of SAS
- A consortium composed of the Institute of Technology, Institute of Physics, Institute of Electrical Engineering, Institute of Inorganic Chemistry, Institute of Materials and Machine Mechanics and Faculty of Electrical Engineering and Information Technology in Bratislava was awarded for the construction of a unique test laboratory “SmartGrid”.

2013 - Medal on the occasion of 60th anniversary of SAS for the best research teams in the SAS

- Conferred by: President of SAS
- Team leaders: P. Komadel, J. Bujdák, Team members: J. Madejová, A. Czímerová, Ľ. Jankovič, H. Pálková, S. Andrejkovičová, J. Hrachová, A. Čeklovský, M. Pentrák
- Team leaders: O.L. Malkina, J. Noga, V.G. Malkin, Team members: P. Hrobárik, S. Kedžuch, S. Komorovský, A. Křístková
- Team leader: P. Šajgalík, Team members: D. Galusek, K. Ghillanyová, M. Hnatko, Z. Lenčéš, M. Michalková, J. Sedláček

Selected individual awards

J. Bujdák

- Gerhard-Lagaly-Award of the DTTG, Conferred by: DTTG - German-Austrian-Swiss Clay Group, 2014
  The DTTG introduced in 2014 the new Gerhard-Lagaly-Award recognizing an outstanding mid-career researcher in clay science. The award was delivered during the international conference MECC 2014 (16. - 19. 9. 2014, Dresden, Germany).
- Honorary Plaque SAS of Dionýz Štúr, 2015
  Conferred by: Presidium of Slovak Academy of Sciences, Description: Award for achievements in natural science, in the field of inorganic, material and physical chemistry.

M. Drábik

- Medal of the Slovak Chemical Society, Conferred by: Slovak Chemical Society, 2012

Z. Lenčéš

- Fellow of the European Ceramic Society, Conferred by: European Ceramic Society for outstanding achievements in research and education in advanced ceramic materials, 2013
- Honorary Plaque SAS of Dionýz Ilkovič, 2015

Conferred by: Presidium of Slovak Academy of Sciences, Description: Award for achievements in physico-chemical sciences in the field of inorganic and materials chemistry

Komadel Peter

- Medal of the Slovak Academy of Sciences for support of science
  Conferred by: Presidium of Slovak Academy of Sciences, 2015

Jana Madejová

- Premium of the Slovak Literary Foundation for a Scientific Echo in last three years (1st place)
  Conferred by: Slovak Literary Foundation, 2015

Malkin Vladimír

- August-Wilhelm Scheer visiting profesor@TUM
  Conferred by: Technical University of Munich (president), 2015

O. Malkin

- Premium of the Slovak Literary Foundation for a Scientific Echo in last three years (2nd place),
  Conferred by: Slovak Literary Foundation, 2013

M. Michálková

- Award from the Competition of the Young Scientists of the SAS for achievements in the development of advanced ceramic materials with unique properties.
  Conferred by: SAS, 2013

J. Noga

- Elected as president of the Learned Society of the SAS, Elected by plenary assembly of the Learned Society of the SAS, 2013
- Elected as member of the International Academy of Quantum Molecular Sciences, www.iaqms.org, 2014

L. Petra

- 1st place in the Best student poster competition
  Conferred by: Organizing committee of Mid-European Clay Conference (16.-19.9.2014, Dresden, Germany)

P. Šajgalík

- Short-Term Overseas Expert (2014-2016)
  Conferred by: The Center for Advanced Materials and Forming Technology, Northwestern Polytechnical University, Xi´An, China, 2014
- Fellow of the European Ceramic Society, 2013
  Conferred by: European Ceramic Society, For outstanding achievements in research and education in advanced ceramic materials.
- Stuijts Award of the European Ceramic Society, 2013
  Conferred by: European Ceramic Society (ECerS), The stuijts Award recognizes an individual for outstanding contributions to ceramics science or technology.
- Honorary doctorate of the Technical University of Ostrava, Czech Republic
  Conferred by: Rector of the University, 2015
- Third Class Ľudovít Štúr Order (Rad Ľudovíta Štúra III. triedy) for development of science and technology and education
  Conferred by: President of Slovak Republic, 2015

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ii. INVITED LECTURES DELIVERED IN INSTITUTIONS ABROAD

Z. Lenčéš: Influence of lanthanoid dopant and N/O substitution on the electronic structure and luminescent properties of silicon oxynitride-based phosphors. Northwester Polytechnical University, XiAn, China, 26.10. 2015.

Z. Lenčéš: Effect of polymer derived SiOC and ternary nitride sintering aids on the thermal

conductivity of silicon nitride. Northwester Polytechnical University, XiAn, China, 27.10. 2015

A. Prnová, R. Klement, D. Galusek: The study of thermal behaviour and HP sintering of aluminate glass microspheres, Department of Inorganic and Physical Chemistry, Gent University, Gent, Belgium, 3.6. 2015.

P. Boháč: Photoactive hybrid materials based on layered silicates and organic dyes, Nanotechnology project center, Shimane University, Matsue, Japan, 18. 4. 2014.

T. Bučko and J. Hafner: Role of local environment in catalytic reactions: computational experiment, Universite de Lorraine, France, 20. 6. 2014.

J. Bujdák: Hybrid systems of organic dyes and clay minerals. Interesting phenomena and potential applications. Invited lecture at Faculty of Mathematics and Physics, Charles University in Prague. Seminar organized by Czech National Clay Group, 27. November, 2014.

J. Madejová: Application of near infrared spectroscopy in organo-clays studies, CETMIC Gonnet, La Plata, Argentina, 11. 3. 2014

J. Madejová: Infrared spectroscopy: a powerful tool in studies of acid-treated clay minerals, University San Martin, Buenos Aires, Argentina, 13. 3. 2014

A. Prnová: Thermal behaviour and phase composition of glasses in the system Y_2O_3- Al_2O_3, Department of Inorganic and Physical Chemistry, Gent University, Gent, Belgium, 22. 10. 2014.

P. Šimurka: Al_2O_3 - ZrO_2 - SiO_2 refractory corrosion in barium soda lime silicate glass melt, Faculty of Materials Science and Ceramics, AGH University of Science and Technology, Krakov, Poland, 1. 12. 2014.

P. Šajgalík: series of 14 presentations, Northwestern Polytechnical University, Xi An, China, 6. - 17. 10. **2014**

M. Drábik: Macro defect free (MDF) materials; the contribution of joint efforts and results of groups in Bratislava and Guildford in this field, University of Surrey, Guildford, U.K., 21. 3. 2013

M. Drábik: Macro defect free (MDF) materials; review on the recent developments, Istanbul Technical University, Istanbul, Turkey, 9. 8. 2013

D. Galusek, R. Klement, A. Prnová, Aluminate Luminescent Glasses, National Taiwan University of Science and Technology, Taipei, Taiwan, 9. 11. 2013

P. Komadel: Smectites in contact with acids, Department of Geology, University of Georgia in Athens, GA, USA, 10. 1. 2013

M. Korenko: Density, viscosity and electrical conductivity of the molten cryolite electrolytes (Na3AlF6–SiO2) for solar grade silicon (Si–SoG) electrowinning, Northeastern University (NEU), Shenyang, China, 21. 10. 2013

Z. Lenčéš: Processing and properties of Al_2O_3-CNT and SiC-CNT nanocomposites, Faculty of Metallurgy and materials Engineering, Technical University Ostrava, Czech Republic 27. 11. 2013

O. Malkin: Recent progress in interpretation of NMR and EPR parameters, NIOCH SB RAS, Novosibirsk, Russia, 16. 7. 2013

O. Malkin: Recent progress in interpretation of NMR and EPR parameters,

- Okazaki University, Okazaki, Japan, 18. 11. 2013
- Nagoya University, Nagoya, Japan, 20. 11. 2013
- Waseda University, Tokyo, Japan, 22. 11. 2013
- Metropolitan University, Tokyo, Japan, 25. 11. 2013
- Sendai University, Sendai, Japan, 29. 11. 2013

V. Malkin: Relativistic calculations of NMR and EPR parameters: do we understand what we are doing? NIOCH SB RAS, Novosibirsk, Russia, 16. 7. 2013

V. Malkin: Relativistic calculations of NMR and EPR parameters,

- Fukui Institute, Kyoto, Japan, 15. 11. 2013
- Okazaki University, Okazaki, Japan, 18. 11. 2013
- Nagoya University, Nagoya, Japan, 20. 11. 2013

- Waseda University, Tokyo, Japan, 22. 11. 2013
- Metropolitan University, Tokyo, Japan, 25. 11. 2013
- Sendai University, Sendai, Japan, 29. 11. 2013

V. Malkin: Is there a natural gauge origin for a spherical atom? Metropolitan University, Tokyo, Japan, 26. 11. 2013

A. Prnová -D. Galusek - R. Klement - K. Bodišová - M. Michálková - V. Pavlík, Study of kinetics crystallization and luminiscence properties of Er and Nd doped yttrium aluminate and aluminosilicate glasses, Department of Inorganic and Physical Chemistry WE06V, University of Ghent, Ghent, Belgium, 16. 12. 2013

J. Bujdák: Interaction between organic dyes and layered silicates and its relevance for potential applications, Department of Material Science, Interdisciplinary Faculty of Science and Engineering, Shimane University, Matsue, Japan, 21. 1. 2012

D. Galusek: Alumina-based materials: New prospects and applications, Institute of Electronic Materials Technology, Warszawa, Poland, 18. 9. 2012

D. Galusek: Aluminate Glasses: Preparation and Properties, GLACERCO Seminar, University of Torino, Italy, 21. 11. 2012

D. Galusek: New trends and developments in alumina-based materials, Darmstadt University of Technology, Darmstadt, Germany, 7. 12. 2012

D. Galusek: Alumina-based materials: new trends and applications, Seminar of CEITEC RG 2-1, Central European Institute of Technology, Brno, Czech Republic, 11. 12. 2012

D. Galusková: Chemical durability of structural ceramics in aqueous solution under hydrothermal conditions, Technische Universität Darmstadt Institut für Materialwissenschaft Fachgebiet Disperse Feststoffe, Darmstadt, Germany, 7. 12. 2012

O. Malkin: Our recent progress in NMR calculations: new methods for number crunching, analysis, and insight, Institut für Organische Chemie, Universität Regensburg, Germany, 10. 07. **2012**

O. Malkin: Visualization and analysis of NMR spin-spin coupling pathways, Clemens-Schoepf Institute, TU Darmstadt, Germany, 16. 10. 2012

O. Malkin: Visualization and analysis of NMR spin-spin coupling pathways, Physics Department, University of Buenos Aires, Argentina, 19. 9. 2012

V. Malkin: Fully relativistic calculations of NMR and EPR parameters,

- Ecole polytechnique fédérale de Lausanne, Institute of Theoretical Physics, France, 12. 4. 2012
- Laboratoire de Chimie Théorique, Institut de Chimie Moléculaire de Grenoble, Université Joseph Fourier, Francúzsko, 17. 4. 2012

V. Malkin: Our recent progress in NMR calculations: new methods for number crunching, analysis and insight, Faculty of Chemistry, University of Warsaw, Poland, 11. 6. 2012

V. Malkin: Relativistic calculations of NMR and EPR parameters,

- Institute of Physical and Theoretical Chemistry, Goethe University Frankfurt, Germany, 15.10. 2012,
- Clemens-Schoepf Institute, TU Darmstadt, Germany, 16. 10. 2012,
- Institut für Physikalische Chemie, Universität Stuttgart, Germany, 18. 10. 2012

V. Malkin: Recent progress in fully relativistic calculations of NMR and EPR parameters,

- Physics Department, University of Buenos Aires, Argentina, 19. 9. 2012,
- Laboratoire de Chimie et de Physique Quantiques, CNRS/ Université Paul Sabatier, Toulouse, France, 7. 12. 2012

J. Noga - J. Šimunek: Alternative exact and robust orbital optimization scheme in quantum chemistry suitable for linear scaling algorithms, Institut Chemii, Uniwersytet Ślaski, Katowice, Poland, 7. 3. 2012

Prnová - A. Piatriková - A. Domanická - M. Migát - B. Hruška - K. Ghilányová - R. Klement - J.

Kraxner - D. Galusek - P. Šajgalík: Preparation and characterization of glasses, ceramics and glassceramics materials in the system Al_2O_3-Re_2O_3, University of Gent, Department of Inorganic and Physical Chemistry, Gent, Belgium, 15. 3. 2012

P. Šajgalík: Electrically Conductive SiC, EMPA, Dübendorf, France, 10. 7. 2012

iii. MEMBERS OF THE EDITORIAL BOARDS

M. Boča

- Chemical Papers (member of Editorial Advisory board since 2/2006; associate editor for Inorganic Chemistry, since 9/2013 to 2013)

M. Drábik

- Ceramics-Silikáty (member)
- Pure and Applied Chemistry (conference editor SSC2014)

D. Galusek

- Ceramics-Silikáty (member)
- New Journal of Glass and Ceramics

P. Komadel

- Applied Clay Science (member)
- Clay Minerals (member)
- Geologica Carpathica (member)

Z. Lenčéš

- Journal of Materials Research, guest editor for themed issue “Nitrides and Oxynitride Materials”, Vol. 30, No. 19 (2015) (ISSN: 0884-2914)

M. Liška

- Ceramics - Silikáty (member)
- European Journal of Glass Science and Technology (regional editor)
- International Journal of Applied Glass Science (member)
- Sklář a keramik (member)

J. Madejová

- Clays and Clay Minerals (associate editor)

P. Šajgalík

- Ceramics - Silikáty (member)
- Journal of Ceramic Science and Technology (member)
- Journal of Asian Ceramic Society (co-editor)
- Keramický Zpravodaj (member)
- Key Engineering Materials (member of International Advisory Board)
- Processing and Application of Ceramics (member)

iv. MEMBERSHIP/LEADERSHIP POSITIONS IN PRESTIGIOUS SCIENTIFIC BODIES

Humboldt Club in Slovakia: M. Boča, D. Galusek, Z. Lenčéš, V. Malkin, J. Noga, P. Šajgalík

Learned Society of the SAS: J. Noga / president, since 11/2013; P. Komadel, J. Madejová, P. Šajgalík

J. Madejová: Slovak National Clay Group / president

P. Komadel: European Clay Groups Association / president 2011 – 2015
The Clay Minerals Society / president 2012 – 2013

P. Šajgalík: European Ceramic Society ECerS / president elect 2014
Slovak Silicate Scientific-Technological Society / president

P. Šimurka: Slovak Glass Society / president

v. INTERNATIONAL FELLOWSHIP

Long-term stays (more than 3 months)

S. Andrejkovičová: Department of Geosciences, University of Aveiro, Portugal, 7/2009 – 6/2012

P. Hrobárik: Institut für Chemie, Technische Universität Berlin, Postdoctoral research fellowship, supported by Alexander von Humboldt and "UniCat" Berlin (Cluster of Excellence within the framework of the Excellence Initiative researching the economically important field of catalysis), 7/2009 – 6/2012

S. Komorovský: Laboratoire de Chimie et Physique Quantiques, Université de Toulouse, France, post-doctoral research position, 4/2011 – 03/2012

S. Komorovský: The Centre for Theoretical and Computational Chemistry, Department of Chemistry, University of Tromsø, Norway, post-doctoral research position, 05/2012 – 05/2015

M. Kontrík: CEMHTI-CNRS (Conditions Extrêmes et Matériaux: Haute Température et Irradiation), Orléans, France, 10/2015 - 03/2016; within National Scholarship Programme of the Slovak Republic

M. Korenko: Engineering College, Valparaiso University, Valparaiso, Indiana, USA postdoctoral fellowship within project ARPA-E (US Department of Energy), 4/2014 – 12/2015

M. Michálková: Fachhochschule Münster – University of Applied Sciences, Germany, Heinrich Herz Stiftung, 2/2011 – 1/2012

M. Michálková: Empa, Swiss Federal Laboratories for Materials Science and Technology, Laboratory for High Performance Ceramics, France, within SCIEX - project ElectroCeram, 2/2012 – 7/2012

M. Michálek: Fachhochschule Münster – University of Applied Sciences, Germany, 2/2011 – 8/2012

M. Michálek: EMPA, High Performance Ceramics Laboratory, Dubendorf, France, postdoctoral position within the project High performance ceramics in harsh environments, 9/2013 – 8/2015

L. Pentráková: Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana, USA, Postdoctoral Research Associate, 6/2012 – 9/2014

M. Pentrák: Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana, USA, Postdoctoral Research Associate, 4/2012 – 9/2014

L. Petra: Sheffield Hallam University, Materials and Engineering Research Institute, United Kingdom, within National Scholarship Programme of the Slovak Republic, 10/2014 – 6/2015

A. Prnová: X-ray science division, Advanced Photon Source, Argonne National Laboratory, Argonne, Illinois, USA, Fulbright grant 15-22-08: Structure of solids and liquids in the Y_2O_3-Fe_2O_3 and Y_2O_3-Ga_2O_3 systems by high energy X-ray diffraction and by Mössbauer spectroscopy, duration: 11/2015 – 03/2016

M. Repiský: The Centre for Theoretical and Computational Chemistry, Department of Chemistry, University of Tromsø, Norway, Norwegian Center of Excellence, 10/2014 – 6/2015

Short-term (2-3 months)

P. Cherry: NMR Research Group, Department of Physics and Chemistry, University of Oulu, Oulu, Finland, 5.9.2015 – 7.12.2015, within project activities 7FP EU PITN-GA-2012-317127 (pNMR).

O. Hanzel: Technische Universität Darmstadt, Disperse Feststoffe, Petersenstrasse 32, 64287 Darmstadt, Germany, within project DAAD (German Academic Exchange service), 10/2012 – 12/2012

B. Kubíková: German Aerospace Center, Institute of Technical Thermodynamics, Stuttgart, Germany, DLR-DAAD fellowship No. 1231 (German Academic Exchange service), 10/2012 – 12/2012

M. Vetrecin: Technische Universität Darmstadt, Germany, within project DAAD (German Academic Exchange service), 10/2012 – 12/2012

P. Boháč: Interdisciplinary Graduate School of Science and Engineering, Shimane University, Matsue, Japan, within National Scholarship Programme of the Slovak Republic, 4/2014 – 6/2014

i. INTERNATIONAL MOBILITY - FOREIGN GUESTS AT IIC SAS

Country	Number (persons)	Days spent at IIC
Argentina	**1**	**10**
Austria	**2**	**199**
China	**1**	**41**
Croatia	**2**	**48**
Czech Republic	**10**	**149**
France	**2**	**8**
Germany	**2**	**84**
India	**2**	**119**
Italy	**1**	**4**
Japan	**1**	**14**
Poland	**3**	**238**
Russia	**3**	**74**
Serbia	**1**	**28**
Sweden	**2**	**65**
USA	**2**	**3**
Overall	**35**	**1084**

35 reasearchers including PhD. students spent in average 31 days at the Institute within bilateral and multilateral projects

List of researchers/PhD. students staying at the IIC more than 20 days

Austria	Christina Atzenhofer	30	2015
	Christina Atzenhofer	28	2014
	Sabine Gschiel	20	2014
	Christina Atzenhofer	24	2013
	Sabine Gschiel	24	2013
	Atzenhofer Christina	32	2012
	Pichlbauer Sabine	32	2012
China	Zengjie Wang	41	2015
Croatia	Andrej Pleša	24	2014
	Maja Vuckovič	24	2015
Czech Republic	Vladana Šamajová	39	2013
Germany	Yuan Jia	30	2013
	Daniela Žitňanská	54	2013
India	Niketan Patel	58	2014
	Raghvendra Singh Yadav	61	2013
Poland	Artur Wodynski	120	2014
	Artur Wodynski	62	2013
Russia	Igor Petrushenko, PhD	30	2015
	Igor Petrushenko, PhD	30	2014
Serbia	Maja Milošević	28	2012
Sweden	Sheryar Khan	60	2014
USA	Shelly A. Arreguin	90	2014
	Shelly A. Arreguin	31	2013

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

- **International projects and funding**

2.4.1. Major projects within the European Research Area and other important project – Framework Programmes of the EU, ERA-NET, European Science Foundation, NATO, COST, INTAS, etc. (here and in items below please specify: type of project, title, grant number, duration, total funding and funding for the institute, responsible person in the institute and his/her status in the project, e.g. coordinator "C", work package leader "W", investigator "I"),

	Project title	Typ / Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute / Responsible person
2012 and earlier	FP7 - Functional nitrides for energy applications	264873	01/2011 - 12/2015	362451	IIC SAS - investigator (P. Šajgalík)
2013	FP7 - Pushing the envelope of nuclear magnetic resonance spectroscopy for paramagnetic systems. A combined experimental and theoretical approach (pNMR)	PITN-GA-2012-317127	01/2013 - 12/2016	126395	IIC SAS - investigator (V. Malkin)
2014	New generation biomimetic and customized implants for bone engineering	COST MP1301	01/2014 - 10/2017	0	IIC SAS - investigator (P. Šajgalík)
	Graphene-ceramic composites for tribological application in aqueous environments	ERANET - GRACE	09/2014 - 08/2017	0	IIC SAS - investigator (P. Šajgalík)
2015	Our Astro-Chemical History	COST M1401	01/2015 - 11/2018	0	IIC SAS - investigator (J. Noga)
	Building-up Centre of Excellence for advanced materials application — CEMEA	664337 - H2020-WIDESPREAD-2014-1	06/2015 - 05/2016		IIC SAS - investigator (M. Boča)

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

– bilateral projects supported from sources of National Research and development agency

[1] Potential influence of potassium and rubidium on the formation of oxofluoroaluminates in solid state, APVV SK-FR-2013-3026, IPROX, Partner: Conditions Extremes et Matériaux: Haute Température et Irradiation (CEMHTI), CNRS, France, coordinator from IIC SAS: František Šimko, 2014-2015
Funding: 2 724.00 €

[2] Physico-chemical analysis of molten fluoride systems for electrowining of solar grade silicon, APVV SK-CN 2012 SolarGradeSilicon, Partner: Northeastern University, Shenyang, China, coordinator IIC: M. Korenko, 2013-2014
Funding: 2 009.00 €

[3] Quantum-chemical calculations of magnetic properties of various chemical compounds with inclusion of relativistic effects, SK-FR-0018-11, Partner: Laboratoire de Chimie et de Physique Quantiques CNRS Toulouse, France, coordinator from IIC SAS: V. Malkin, 2012-2013

Funding: 4 886.00 €

[4] Thermodynamic models and structure of multi-component glasses, TERMOSK SK-CZ-0007-11, coordinator from IIC: M. Chromčíková, Partner: University of Pardubice Faculty of Chemical Technology, Czech Republic, 2012-2013
Funding: 3 307.00 €

[5] Molecular simulations of selected organoclays - characterization of structure and properties, SK-AT-0020-10; coordinator from IIC: Eva Scholtzová; Partner: Universität für Bodenkultur Wien (BOKU), Austria, 2011-2012
Funding: 2 160,00 €

- international projects supported from sources of SAS (MVTS)

[1] FP7-FUNEA: Functional nitrides for energy applications, Project No.: 264873, project coordinator: Technische Universtät Darmstadt, Germany, 6 countries involved, 9 participanting institutions, coordinator from IIC SAS: P. Šajgalík
Funding: 35 689.00 €

[2] FP-7-pNMR: Pushing the envelope of nuclear magnetic resonance spectroscopy for paramagnetic systems. A combined experimental a theoretical approach (pNMR), Project No.: PITN-GA-2012-317127, project coordinator: Centre Europeen de RMN a Tres Hauts Champs, France, 9 countries involved, 12 participanting institutions, coordinator from IIC SAS: V. Malkin
Funding: 19 179.00 €

[3] COST: Our Astro-Chemical History, Project No: CMST COST Action CM1401, project coordinator: Institut de Planétologie at dAstrophisique de Grenoble, France, 10 countries involved, 10 participanting institutions, coordinator from IIC SAS: J. Noga
Funding: 4 600.00 €

[4] COST: New generation biomimetic and customized implants for bone engineering, Project No: MPNS COST Action MP1301, project coordinator: Belgium Ceramic Research Centre Mons, 56 institutions from more than 20 countries, coordinator from IIC SAS: P. Šajgalík
Funding: 7 667.00 €

[5] ERANET: Graphene-ceramic composites for tribological application in aqueous environments. project coordinator: Fraunhofer-Gesellschaft, Institut für Werkstoffmechanik IWM, Germany, 3 countries involved, 6 participanting institutions, coordinator from IIC SAS: P. Šajgalík
Funding: 9 300.00 €

[6] Horizon 2020: Building-up Centre of Excellence for advanced materials application — CEMEA, 664337 - H2020-WIDESPREAD-2014-1, project coordinator: Slovak Academy of Sciences Partners: Finland - Teknologian tutkimuskeskus VTT OyEspo, HELSINGIN YLIOPISTO, Slovakia - Institute of Physics SAS, Institute of Electrical Engineering
Funding: 0 €

[7] Preparation and characterization of alumina and silicon nitride-based nanocomposites for cutting of hard-to-machine material, SAS-NSC-2010-02, Partner: Department of Materials Science and Engineering National Cheng Kung University Taiwan, coordinator from IIC SAS: P. Šajgalík
Funding: 40 000.00 €

[8] New rare earth-free inorganic phosphors for energy-saving lighting applications, SAS-NSC JRP 2012/14, partner: National Taiwan University of Science and Technology, coordinator from IIC SAS: D. Galusek
Funding: 66 000.00 €

[9] BioKer - Development of ceramics composites materials for bio-applications, SAS - TUBITAK JRP 2013/02, 2013-2016, Partner: TUBITAK Marmara Research Center, Barış Mah, Turkey. coordinator from IIC SAS: P. Šajgalík
Funding: 54 000.00 €

- projects supported from other sources

[1] Alternative Werkstoffe fur Pumpenkomponenten, coordinator from IIC: M. Drábik; partners: Materials Center GmbH Leoben, Montanuniversität Leoben, Andritz A.G. Graz; 2011 – 2015
Funding: 28 017.00 €

[2] Ceramic coatings with glass fillers for high temperature corrosion protection of metals, coordinator from IIC: D. Galusek, partner: University of Bayreuth, Germany, 2014-2016, Funding: 27 000.00 €

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

[1] High strength and toughness ultra high temperature ceramics reinforced by fibers and carbon nanotubes, coordinator from IIC: Zoltán Lenčéš, partner: Institute of Science and Technology for Ceramics CNR Faenza, Italy, 2010-2012

[2] Hafnia- and Hafnium Nitride-Based Ceramic Nanocomposites with Improved High-Temperature Oxidation and Corrosion Resistance; coordinator from IIC: Pavol Šajgalík; partner: Technische Universität Darmstadt, Germany, 2010-2012

[3] Thermodynamic models and structure of multi-component glasses, TERMOSK SK-CZ-0007-11, coordinator from IIC: M. Chromčíková, Partner: University of Pardubice Faculty of Chemical Technology, Czech Republic, 2012-2013

[4] Atomic level aspects of advanced cementitious materials; coordinator from IIC: M. Drábik; partner: University of Surrey (Chemistry C4), UK; 2006 – 2012

[5] Ceramic Nanocomposites for Applications in Extreme Environments, DAAD/SAV 54440408, coordinator from IIC: Pavol Šajgalík; partner: Materialwissenschaft Technische Universität Darmstadt, Germany, 2012-2013

[6] Porous inorganic materials derived from layered silicates: synthesis, stability and functionality; coordinator from IIC: J. Madejová; partner: Institute of Catalysis and Surface Chemistry, PAS, Krakow, Poland; 2010 – 2012

[7] Organo-clays as intermediates for the synthesis of functional hybrid materials, MAD No. 14, partner: Institute of Catalysis and Surface Chemistry PAS, Poland, coordinator from IIC: Pálková Helena, 2013 – 2015

- **National projects and their funding**

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

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

	Project title	Typ / Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute / Responsible person
2012 and earlier	Inorganic fluoride melts - the complex study of spectral, diffraction, physicochemical, thermodynamical and structural characteristics	APVV-0460-10 ZrAlTa	05/2011 - 10/2014	194443	coordinator (M. Boča)
	Photoactive hybrid nanomaterials with luminescent and antimicrobial properties	APVV-0291-11 HybridMater	07/2012 - 12/2015	Total: 206 075 IIC: 85500	coordinator (J. Bujdák)
	Mechanisms of corrosion and micromechanical properties of dental materials	APVV-0218-11 KoroDENT	07/2012 - 12/2015	Total: 160000 IIC: 119459	coordinator (D. Galusek)
	Development of Si3N4 with addition of grapheme platelets	APVV-0161-11 SiNGra	07/2012 - 12/2015	IIC: 80000	investigator (P. Šajgalík)
	Organoclays and their composites with polymers	APVV-0362-10 OC&PCN	05/2011 - 10/2014	Total: 199239 IIC: 119000	coordinator (P. Komadel)
	Relativistic calculations of parameters of NMR and EPR spectroscopy for compounds containing heavy elements: further methodological development and applications	APVV-0483-10 ReSpect	05/2011 - 10/2014	108 292	coordinator (V. Malkin)
	Development of composite biomaterials based on silicon nitride	APVV-0500-10 BioNitrid	05/2011 - 10/2014	Total: 189687 IIC: 144000	coordinatorr (P. Šajgalík)
	Structure and properties of oxide glasses for application in nuclear power technology	APVV-0487-11 SVOJE	07/2012 - 12/2015	74 256	investigator (M. Chromčíková)
	Polyapplicable heterocycles - design, synthesis and properties	APVV-0038-11 PAPHET	07/2012 - 12/2015	3 172	investigator (Ľ. Smrčok)
	Glasses and glass ceramics based on rare earth aluminates	LPP-0133-09 ReAlGlass	09/2009 - 08/2012	11 174	coordinator (D. Galusek)
	Correspondence seminars from chemistry and biology for secondary schools and seminar of natural sciences for elementary schools	LPP-0277-09 KORSEM	09/2009 - 08/2013	46 016	coordinator (S. Kedžuch)
	Multireference explicitly correlated coupled cluster theory within the R12	LPP-0343-09 MRCCR12	09/2009 - 08/2012	11 070	coordinator (J. Noga)
	Relativistic calculations of NMR and EPR parameters: from numbers to insight	LPP-0326-09 RelChem	09/2009 - 08/2013	31 190	coordinator (O. Malkin)
	Luminescence of silicon oxynitrides and nitrides prepared via organometallic precursors	LPP-0394-09 LUMSILOX	09/2009 - 08/2012	10 440	coordinator (P. Šajgalík)
	A study of the potential of fluoride molten salts for high temperature applications	LPP-0344-09 SPFTVTA	09/2009 - 08/2013	30 192	coordinator (M. Boča)
	Modern application of fluoride molten salts	LPP-0345-09 MVFT	09/2009 - 08/2012	9974	coordinator (M. Boča)
2013	Development SiC based conductive ceramics	APVV-0108-12 ConCer	10/2013 - 09/2017	26 089	investigator (P. Šajgalík)
	Perlite genesis and innovative approaches to its exploitation and processing	APVV-0339-12 Perlit	10/2013 - 09/2017	23 361	investigator (J. Madejová)
2014	no call in 2013				
2015	Silicon oxynitride-based photoluminescent ceramic materials	APVV-14-0385	07/2015 - 06/2019	Total: 30511 IIC: 17552	coordinator (Z. Lenčéš)

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

VEGA	2012	2013	2014	2015
Number	12	12	13	12
Funding in the year (EUR)	106811	113665	126326	123651

[1]

- **Summary of funding from external resources**

2.4.6. List of projects supported by EU Structural Funds

[1] MACHINA II - Centre for Materials, Layers and Systems for the Applications and Chemical Processes in the Extreme Environments – Stage II. ITMS 26240120021
Duration: 04/2010 - 03/2012
Coordinator IIC SAS: doc. Ing. Miroslav Boča, PhD.
Partners: Institute of Chemistry SAS, Polymer Institute SAS, Faculty of Chemical and Food Technology, Slovak University of Technology - Coordinated by IIC

[2] Center of Excellence for Ceramics, Glass and Silicate Materials. ITMS 262 201 20056
Duration: 06/2010 - 05/2013
Coordinator IIC SAS: doc. Ing. D. Galusek, PhD.
Partners: Institute of Materials Research of SAS, Alexander Dubček University of Trenčín

[3] Centre of Knowledge Commercialization and Intellectual Property Rights Management of the Slovak Academy of Sciences. ITMS 26240220006
Duration: 04/2010 - 03/2013
Project coordinator: Institute of Technology SAS
Coordinator IIC: doc. Ing. P. Šimurka, PhD.
Other partners: Institute of Physics SAS, Institute of Materials & Machine Mechanics SAS, Institute of Electrical Engineering SAS

[4] PLASMAT - High-flow Plasma Generator Based on Composite Materials for Gasification of Solid Hydrocarbons. ITMS 26240220054
Duration: 10/2010 - 03/2013
Project coordinator: CELIM Slovakia
Coordinator IIC: Ing. Jaroslav Sedláček PhD.

[5] PVTECHSKLO - Industrial Research for Needs of the Reengineering of the Unique Technology of the Glass Preparation and the Forming Work. ITMS 26220220072
Duration: 04/2010 - 03/201
Project coordinator: RONA j.s.c.
Coordinator IIC: doc. Ing. P. Šimurka, PhD.

[6] ZDESJE - Knowledge Database and Expert System for Environmental Friendly Solutions of Loss of Coolant Accidents in Atomic Nuclear Power Plants. ITMS 26220220084
Duration: 04/2010 - 03/2014
Project coordinator: VÚEZ, j.s.c.
Coordinator IIC: doc. Ing. P. Šimurka, PhD.

[7] Applied Research of Technology of Thermal Plasma Processes. ITMS 26240220070
Duration: 01/2011 - 12/2013
Project coordinator: Geothermal Anywhere, Ltd.
Coordinator IIC: doc. Ing. Miroslav Boča, PhD.

[1] Excluding projects for the popularisation of science

[8] ENERGOZ - Effective Control of Production and Consumption of Energy from Renewable Sources. ITMS 26240220028
Duration: 2010 – 2013
Project coordinator: Institute of Technology SAS
Coordinator IIC: doc. Ing. P. Šimurka, PhD.
Other partners: Institute of Physics SAS, Institute of Materials & Machine Mechanics SAS, Institute of Electrical Engineering SAS, Slovak University of Technology Bratislava

[9] Competence Center for new Materials, Advanced Technologies and Energy. ITMS 26240220073
Duration: 2011 – 2014
Project coordinator: Institute of Electrical Engineering SAS
Coordinator IIC: doc. Ing. M. Hnatko, PhD.

[10] University Science Park of STU Bratislava, ITMS 26240220084
Duration: 02/2013 - 01/2015
Project coordinator: Slovak University of Technology, Bratislava
Coordinator IIC: doc. Ing. Miroslav Boča, PhD.
Other partners: Comenius University Bratislava, Institute of Electrical Engineering SAS

[11] Center for applied research of new materials and technology transfer, ITMS 26240220088
Duration: 03/2013 - 03/2015
Project coordinator: SAS
Coordinator IIC: prof. RNDr. P. Šajgalík, DrSc.
Other partners: Slovak University of Technology, Academy of Fine Arts and Design

[12] Investigation and verification of catalytic dehalogenation on reactive barriers technologies - treatment of contaminated water from polluted industrial sites, ITMS 26240220078
Duration: 02/2014 - 10/2015Project coordinator: DEKONTA
Coordinator IIC: Mgr. A. Czímerová, PhD.

[13] Research centre ALLEGRO, ITMS 26220220198,
Duration: 04/2014 - 12/2015
Coordinator IIC: prof. Ing. Dušan Galusek, DrSc.
Partners: Institute of Physics SAS, Institute of Materials & Machine Mechanics SAS, Institute of Electrical Engineering SAS, Slovak University of Technology Bratislava

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

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

Year	Project title	Project number	Duration in months	Funding for the Institute (EUR)	Role of the Institute
2012 and earlier	Centre for Materials, Layers and Systems for the Applications and Chemical Processes in the Extreme Environments – Stage II	26240120021 Machina	05/2009 - 03/2012	Total: 1676205 IIC: 905134	coordinator (M. Boča)
	Center of Excellence for Ceramics, Glass and Silicate Materials	26220120056 CEKSIM	06/2010 - 50/2013	Total: 1943301 IIC: 1315458	coordinator (D. Galusek)
	Centre for knowledge marketing and intellectual property rights of SAS	26240220006 CEKOODUV	09/2009 - 02/2012	731	investigator (P. Šimurka)
	High-flow Plasma Generator Based on Composite Materials for Gasification of Solid Hydrocarbons	26240220054 PLASMAT	10/2010 - 03/2013	44833	investigator (J. Sedláček)
	Industrial Research for Needs of the Reengineering of the Unique Technology of the Glass Preparation and the Forming Work	26220220072 PVTECHSKLO	04/2010 - 04/2015	214439	investigator (P. Šimurka)
	Knowledge Database and Expert System for Environmental Friendly Solutions of Loss of Coolant Accidents in Atomic Nuclear Power Plants	26220220084 ZDESJE	04/2010 - 05/2015	648327	investigator (M. Liška)
	Applied Research of Technology of Thermal Plasma Processes	26240220070 Geothermal	01/2011 - 12/2013	317863	investigator (M. Boča)
	Effective Control of Production and Consumption of Energy from Renewable Sources	26240220028 ENERGOZ	04/2010 - 03/2013	213782	investigator (P. Šimurka)
	Competence Center for new Materials, Advanced Technologies and Energy	26240220073	06/2011 - 12/2015	65227	investigator (M. Hnatko)
2013	University Science Park of STU Bratislava	26240220084	02/2013 - 10/2015	91442	investigator (M. Boča)
	Center for applied research of new materials and technology transfer	26240220088	03/2013 - 12/2015	139753	investigator (P. Šajgalík)
2014	Research centre ALLEGRO	26220220198	04/2014 - 12/2015	316948	investigator (D. Galusek)
	Investigation and verification of catalytic dehalogenation on reactive barrier technologies - treatment of contaminated water from polluted industrial sites	26240220078	02/2014 - 10/2015	813322	investigator (A. Czímerová)
2015					

External resources	2012	2013	2014	2015	total	average
External resources (milions of EUR)	2.780	0.504	0.508	1.325	**5.117**	**1.279**
External resources transfered to coooperating research institute (milions of EUR)	1.758	0.356	0.000	0.000	**2.114**	**0.529**

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

During the assessment period, the Institute participated in both national and international project proposals in various schemes (all details are shown above). The following facts can be summarised:

a. Success in national projects is significantly higher than success in international projects, because the national grant agencies approve a higher proportion of proposals than international schemes. On the other hand, these national agencies provide less in the way of financial resources, although this difference becomes smaller when normalised for the number of institutional partners (i.e. in a national project there are 2-5 partners sharing the total budget, whereas in international projects it is not unusual for the budget to be spread between 10 partners). Unfortunately, national projects do not involve such extensive international cooperation, which is one of the primary aims of the Institute.

b. The Institute is among the most successful institutes of the SAS in obtaining EU Structural Funds, with 13 projects. The resources were relatively high, higher in fact than funding from international schemes tends to be. The majority of these financial sources were allocated for infrastructure.

c. The major part of financial sources for research comes from projects, and only a relatively small amount comes from industrial partners. The total funding from national industrial partners is smaller than from international partners, even though the number of the former is higher.

These facts result from specific aspects of the Slovak national research strategy and (unfortunately) the scientific institution cannot influence these aspects much (e.g. the low amount of funding from the various agencies, complicated legislation, low involvement of industry in research activities). Given that the conditions for obtaining funding are far from the ideal, the Institute can be said to be rather successful in doing so.

The above list of projects only provides information about successful projects. It should be noted that researchers were also active in some other schemes not mentioned above, but which have yet to produce enough results to merit inclusion (involvement of the Institute in Marie-Curie fellowships and ERC projects, other projects in the H2020 scheme).

2.5. PhD studies and educational activities

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

The Institute of Inorganic Chemistry is accredited to provide doctoral studies as an external educational institution in collaboration with the Slovak University of Technology (SUT) and Comenius University (CU), with the right to issue a PhD certificate.

Doctoral study fields:

- **Chemical Physics / 4.1.11**
  Faculty of Natural Sciences, CU, Bratislava
  Guarantor of the programme: prof. RNDr. Jozef Noga, DrSc.
- **Inorganic Chemistry / 4.1.15**
  Faculty of Natural Sciences, Comenius University, Bratislava
  Guarantor of the programme: RNDr. Peter Komadel, DrSc.
- **Inorganic Technology and Materials / 5.2.19**
  Faculty of Chemical and Food Technology, Slovak University of Technology, Bratislava
  Guarantor of the programme: prof. RNDr. Pavol Šajgalík, DrSc.

Period of validity of accredited scientific disciplines: undeterminate

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

PhD study	31.12.2012			31.12.2013			31.12.2014			31.12.2015		
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	15.0	0.0	0.0	15.0	4.0	0.0	11.0	3.0	2.0	8.0	2.0	1.0
External	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0
Other supervised by the research employees of the institute	5.0	0.0	0.0	3.0	2.0	0.0	1.0	2.0	0.0	2.0	0.0	0.0

Foreign students involved in IIC SAS projects (FP7) and performing their study at Slovak University - internal

- Peter John Cherry - University of Warwick, Great Britain
- Ismail Ibrahim - Helwan University, Cairo, Egypt

Foreign students involved in IIC SAS projects (FP7) and performing their study at foreign universities (co-supervised by IIC SAS researchers)

- Ing. Monika Hrabalová - VŠB, Technical University of Ostrava, Czech Republic

Other foreign students co-supervised by IIC SAS researchers
- Ing. Christina Atzenhofer Montanuniversitaet Leoben, Austria,
- Sabine Pichlbauer, Montan Universitaet Leoben, Austria,
- Ing. Evelyn Andrea Bolaňos Castro - VŠB, Technical University of Ostrava, Czech Republic
- Ing. Vladana Šamajová - VŠB, Technical University of Ostrava, Czech Republic

2.5.3. Summary table on educational activities

Teaching	2012	2013	2014	2015
Lectures (hours/year)[2]	16	94	15	86
Practicum courses (hours/year)[2]	538	1006	310	168
Supervised bachelor theses (in total)	3	1	0	0
Supervised diploma theses (in total)	7	5	3	0
Supervised PhD theses (in total)	23	36	29	18
Members in PhD committees (in total)	7	11	9	6
Members in DrSc. committees (in total)	1	2	2	2
Members in university/faculty councils (in total)	10	11	13	14
Members in habilitation/inauguration committees (in total)	1	3	5	2

2

2.5.4. List of published university textbooks

2.5.5. Number of published academic course books

2.5.6. List of joint research laboratories/facilities with universities

Joint laboratories:

- Joint research laboratory on advanced ceramic materials with Northwestern Polytechnical University, Xi-An, China (signed on 26.10.2015 in NPU, Xi/An).
- Joint Laboratory of Glass of the Institute of Inorganic Chemistry, Slovak Academy of Sciences with the Faculty of Chemical and Food Technology, Slovak University of Technology and Alexander Dubček University of Trenčín

Joint facilities with universities and research institutes:

IIC SAS has in 2012-2015 two types of joint facilities with universitites and research organizations obtained within common projects:

- Owned by IIC SAS and shared for other institutions – *e.g.*, XRD spectrometer BRUKER D8, Panalytical Empyrean, XRF spectrometer ARL Advant'X, thermal analyser STA Jupiter F3,

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

SEM JEOL, AAS spectrometer Varian, ICP OES Varian, UV-VIS-NIR Cary 5000, Fluorescence spectrometer Fluorolog-3, FTIR spectrometer Nicolet 6700

- Owned by other institutions and shared for IIC SAS – *e.g.*, HRTEM Titan Themis, automatic press KPG 400, cold isostatic press CIP 400-300*750Y, continuous graphite furnace FCW, lapping machine DSG720

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

At least 14 PhD themes have been announced annually by IIC SAS in the study programmes 4.1.15 Inorganic Chemistry, 5.2.19 Inorganic Technology and Materials, and 4.1.11 Chemical Physics. The number of PhD students has been strongly affected by the number of available fellowships from the Presidium of SAS, but also by the interest of university students in continuing their studies at the PhD level.

IIC also has support for PhD students from external sources, such as SRDA (one student), 7 RP EU FUNEA (two students), one student within a collaboration with a foreign university (Faculty of Metallurgy and Material Engineering, VŠB Technical University of Ostrava, Czech Republic) and one student from Helwan University, Cairo, Egypt.

Several PhD. students have absolved research stays at the cooperating foreign institutions longer than 2 months with the aim to gain experiences and skills in laboratory, to learn new methods, etc.

- P. Boháč: Interdisciplinary Graduate School of Science and Engineering, Shimane University, Matsue, Japan, within National Scholarship Programme of the Slovak Republic, Slovak Academic Information Agency - SAIA, 4/2014 – 6/2014
- P. Cherry: NMR Research Group, Department of Physics and Chemistry, University of Oulu, Oulu, Finland, 5.9.2015 – 7.12.2015, within project activities 7FP EU PITN-GA-2012-317127 (pNMR).
- O. Hanzel: Technische Universität Darmstadt, Disperse Feststoffe, Petersenstrasse 32, 64287 Darmstadt, Germany, within project DAAD (German Academic Exchange service), 10/2012 – 12/2012
- M. Kontrík: CEMHTI-CNRS (Conditions Extrêmes et Matériaux: Haute Température et Irradiation), Orléans, France, within National Scholarship Programme of the Slovak Republic, Slovak Academic Information Agency - SAIA, 10/2015 - 03/2016
- M. Michálek: Fachhochschule Münster – University of Applied Sciences, Germany, 2/2011 – 8/2012
- L. Petra: Sheffield Hallam University, Materials and Engineering Research Institute, United Kingdom, within National Scholarship Programme of the Slovak Republic, Slovak Academic Information Agency - SAIA, 10/2014 – 6/2015
- M. Vetrecin: Technische Universität Darmstadt, Germany, within project DAAD (German Academic Exchange service), 10/2012 – 12/2012

To promote high-quality research among the young scientists and students, the Institute annually organizes a Competition of Young Researchers in collaboration with the Institute of Inorganic Chemistry of the Academy of Sciences of the Czech Republic. A one-day seminar is devoted to lecture presentations of their work. The best lectures are also awarded with a stipend to attend an international conference.

The long-term policy of the Institute is to support young scientists in starting their carrier as postdoctoral fellows at reputable institutions abroad, taking advantage of our well-established bilateral cooperation with universities and research facilities all over the world.

Characterization of research avenues of PhD study in the Organisation

Research possibilities for PhD study on IIC have substantially increased after obtaining new instruments under the EU SF projects. High-quality infrastructure can be a motivating factor for incoming PhD students. An increase in the number of senior researchers from 28 (at present) to 35 within the next five years is expected, resulting in an increased number of PhD supervisors and a higher number of supported internal PhD students at the Institute. The Institute has also started communication with foreign countries in order to find ways to accept PhD. students from countries other than Slovakia. This effort will form a key part of the Institute's strategy regarding personnel.

2.6. Social impact

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

[1] Development of magnesia-spinel-based refractories bonded with oxynitride-based ceramics in co-operation with RHI AG, Technology Center, Austria. European patent No.: EP 2730551 A1; title: "Development of magnesia-spinel-based refractories"
Authors: Z. Lenčéš, P. Šajgalík (from IIC SAS), S. Pichlbauer-Gschiel, H. Harmuth (from Montanuniversität Leoben, Austria)

[2] Development of aluminate glasses with luminescent properties.
Authors: D. Galusek, A. Prnová, R. Klement, J. Kraxner, K. Bodišová
Novel aluminate glass-based light emitting phospors with a composition of Al_2O_3-RE_2O_3-SiO_2, ZrO_2 (where RE = Y, Yb, La) were prepared by flame synthesis and compacted by pressure sintering. The glass-based phospors thus developed have better efficiency than silicate glass-based phosphors and can be applied in high-brightness LEDs or lasers, in both cases with energy savings.

[3] Development of cost-effective production of ternary silicon nitride-based phosphors for white LEDs by self-propagating high-temperature synthesis in co-operation with AIST Nagoya, Japan. Japanese patent No. 5077930
Title: "Preparation of nitride phosphors by combustion synthesis"
Inventors: Z. Lenčéš (IIC SAS), Kiyoshi Hirao and You Zhou (AIST)

[4] The IIC joined the SAS project SMARTGRID (intelligent powerline network) which is to exhibit possible material-development contributions by the research institutes towards green energy and energy efficiency. An effective powerline network was built which utilizes the energy from the Sun and Earth, and with high efficiency controls the energy demand and supply. The Institute contributed to the project by development of an excess heat storage tank, which can supply energy during the night or cloudy days (low sunlight). For heat storage materials nitrate-based salts were used, and their heat capacity and other physico-chemical properties were optimized. The second contribution was the development of efficient light emitting phosphors used for the construction of low consumption, energy saving LEDs. The project received the Award of the SAS.
Inventors from IIC SAS: V. Pavlík, Z. Lenčéš

[5] Development of the fluoride-based molten salt process for the recovery of transition metals and refractory metals mainly used in nuclear plants. The electrolytic refinery process was optimized for the recovery of zirconium from these special alloys and wastes. It was shown that the degree of dissolution of metal in the fluoride melt strongly depends on the electrochemical potential. Additionally, an advanced accelerated aging test was developed during this study.

Inventors from IIC SAS: V. Pavlík, M. Boča

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

Individual studies are not listed here; but such reports (at least one per person per year) are an inseparable part of the duties of the following employees who have served as members of such bodies:

J. Bujdák

- Representative of the Slovak republic at the International Chemistry Olympiad organised by the University of Maryland, USA, 2012, (delegated by Ministry of Education, Science, Research and Sport of SR)

D. Galusek

- External member of the committee for objections in public procurement (Body of the Slovak Government - Office for Public Procurement)

S. Kedžuch

- Slovak Committee for Chemistry Olympiad, Slovak Youth Institute, Ministry of Education, Science, Research and Sport of the SR (vice-president since 2012)
- Co-author of the tasks for the Chemistry Olympiad in group F for students of secondary schools (organized by IUVENTA, Slovak Youth Institute)

J. Madejová

- Member of the Council for Natural Sciences; Slovak Research and Development Agency (since 2014)

M. Korenko

- Member of the committee for objections in public procurement - external member (Body of the Slovak Government - Office for Public Procurement)

J. Noga

- Member of the Working Group for Chemistry and Chemical Technology of the Accreditation Committee of the Slovak Republic (Accreditation Commission Counselling body of the Government of the Slovak Republic)

P. Šajgalík

- Committee for evaluation of applications of stimuli for research and development (advisory body of the Ministry of Education, Science, Research and Sport of the Slovak Republic)
- Committee of Ministry of Education, Science, Research and Sport of the Slovak Republic for Awards of Ministry of Education (member)
- Slovak committee for scientific degrees (president)
- Slovak Research and Development Agency - committee for new methods of project evaluation (president)
- Member of Council of Programme “PP7RP”, Slovak Research and Development Agency
- Member of Council of International Cooperation, Slovak Research and Development Agency
- Provided expertise for the Government of Slovak Republic: Knowledge towards prosperity - Strategy for research and innovation for smart specialisation of Slovak Republic, 2013
- President of Council of presidents for research priorities, Ministry of Education, Science, Research and Sport of the Slovak Republic

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

[1] Common laboratory of IIC SAS and RONA, Inc.
Partner: Rona a.s., Lednické Rovne, Slovakia
Description: Stimulation, development and realization of both, basic and applied research - common projects
Foundation: 2011

[2] SiAlON-bonded MgO and Al_2O_3 based refractories
Partners: RHI AG, Technology Center, Leoben, Austria and Montan Universität, Leoben, Austria
Duration of contract: 2008 - 2015
Funding (€): 37 590.00
Development of new materials based on Al_2O_3-SiAlON and MgO-MgAlON

[3] Alternative materials for pump components
Partner: Materials Center Leoben, Austria; Andritz GmBH, Graz, Austria
Duration of contract: 2011-2014
Funding (€): 28 017.00

[4] Macro-defect-free concretes - revision, No. 90 KH / 2015
Partner: PC Ladce, a. s.
Contract duration: 2015
Funding (€): 6250

[5] Brief description: Optimization of composition H-cement and poly-P cements, conditions for preparation/production of MDF materials based on H-cements.
Coordinator IIC: M. Drábik
Expertise provided on request of industrial partner PC Ladce, a.s., 90 KH/2015, 501/Mi/2015

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

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

2.6.6. Summary of relevant activities, max. 300 words

The social impact of the activities of IIC SAS involves the energy saving (development of efficient phosphors for light emitting diodes, application of molten salts for heat storage and transfer, cooling of nuclear plants), environment (application of modified clay minerals for waste handling, purification of water, NMR and EPR analysis of heavy elements) and better life of older generation (ceramic implants as bone substitutes).

The participation of IIC SAS in European projects gives a chance to SMEs from Slovakia to join these research consortia as an industrial partner, be a beneficiary of achieved know-how, and make contacts with foreign companies. The participation of Slovak SMEs together with IIC in EU projects might generate new employments for young experts.

The local social impact is on young researchers who finished their PhD at IIC SAS. The high scientific level of supervisors from IIC, the good infrastructure enable the young researchers to gather a very wide understanding in the range of disciplines (chemistry, engineering, processing, computer simulations) with emphasis on interdisciplinary thinking, implementing and practicing. These benefits should help them to find a position in well recognized companies or research institutes.

2.7. Popularisation of Science (outreach activities)

2.7.1. List of the most important popularisation activities, max. 20 items

Articles in printed media

[1] Olga Malkina, Vladimír Malkin, "El Litoral Corrientes" - interview for Argentinian newspaper, 16.9.2012

[2] Pavol Šajgalík, "Ancient Venus of Vestonice and bullet proof ceramic armour - what they have in common", Journal Pravda, 25.2.2012 (http://dennik.pravda.sk/Pravda.aspx?datum=25.2.2012#32)

[3] Pavol Šajgalík, "Chemist Šajgalík: Neutrinos excited not only the physists", Neutrína zdvihli zo stoličiek nielen fyzikov, journal SME, 11.1.2012

[4] Peter Komadel, "Chemist Komadel: I have explored a trivial thing and everybody was laughing", Vymyslel som triviálnu vec a každý sa smial,journal SME, 31.7.2013

[5] Vladimír Malkin, "About molecules with Vladimír Malkin", periodic journal Týždeň, pp. 43, 24.6.2013

[6] Vladimír Malkin, Oľga Malkina, "Two Russians on the top of Slovak science", journal Pravda, pp. 20-22, 5.10.2013

[7] Pavol Šajgalík, Zoltán Lenčéš, "Light and lighting otherwise - research of phosphors at the Institute of Inorganic Chemistry", journal Quark, pp. 20-21

[8] Milan Drábik, "Materials chemistry: from definition to the series of actual topics", Chemical horizons, 8.10.2014

Appearance in telecommunication media:

[1] Pavol Šajgalík, director of IIC SAS - interview about science and scientists, and also about how grandmother's cup is related to a space shuttle's ceramic heat shield, Radio Best FM, 29.5.2013

[2] Miroslav Boča, broadcast in TV Bratislava "Petržalských 13" (interview), 18.4.2014

[3] Peter Boháč, Anna Brtáňová, broadcast in radioRTVS– Slovensko: "We were there" – an interview from Researchers' Night called "Children get acquainted with scientific knowledge", 26.9.2014

[4] Dušan Galusek, TV broadcast in STV 2, "VAT - Luminescent materials as energy-efficient lighting sources", 5.1.2015

[5] Miroslav Hnatko, TV broadcast in STV 2, "VAT: Laboratory hot press ONE", 11.4.2015

[6] Miroslav Hnatko, TV broadcast in TA3: "Science in reach: Application of engineering ceramics in everyday life", 2.6.2015

Public popularisation lectures

[1] Miroslav Boča, "Everyday chemistry", lecture for 7th grade primary school students in Petržalka as part of the project Super-school of Petržalka – Science is not boring, DK Zrkadlový háj, Bratislava-Petržalka, 19.12.2012

[2] Jozef Noga, "Introduction to quantum chemistry" (2 lectures), Specialized workshop on chemistry for secondary schools, 6.-7.6. 2012

[3] Márius Kádek, L. Konečný, "Is chemistry physics or magic?", FMFI, Comenius University Bratislava, 25.9.2013

[4] Peter Komadel, "Important clays and clay minerals: bentonite and montmormorillonite, their appearance, properties and applications", National center for the popularisation of science and technology in the society, 15.4.2014

[5] Oľga Malkin, From a woman in science to science as a family enterprise, University of Würzburg, Germany, 4.7.2014

[6] Vladimír Malkin, "Sustainable science: from a man in science to science for humankind", International sustainability week at the University of Würzburg, 4-13.7.2014, Würzburg, Germany, 4.7.2014

[7] Anna Prnová, Robert Klement, Dušan Galusek, “Optical applications of aluminate glasses”, lecture within the project Joint school – a series of lectures for primary school students, Nová Dubnica, 13.11.2014

[8] Pavol Šajgalík, “Why does the space shuttle have a ceramic shield?”, lecture within the project Joint school – a series of lectures for primary school students, Bratislava, 9.12.2014

2.7.2. Table of outreach activities according to institute annual reports

Outreach activities	2012	2013	2014	2015	total
Articles in press media/internet popularising results of science, in particular those achieved by the Institute	8	10	1	2	21
Appearances in telecommunication media popularising results of science, in particular those achieved by the Institute	0	4	2	4	10
Public popularisation lectures	2	2	9	3	16

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

The Open Door Day is organised annually during the Slovak Science and Technology Week, principally for introducing the activities of the institute to secondary school students and their teachers. The number of annual visitors has been trending upwards, reaching a maximum of 270 people in 2014.

Since the year 2007 the European Researchers´ Night has been organized by the SAS, Slovak Organization for Research and Development activities (SOVVA) and Slovak Centre of Scientific and Technical Information (CVTI), and our Institute participates regularly in this event. The Researchers´ Night is dedicated to making science popular and learning fun, and should bring researchers closer to the broader public and show what researchers really do for society, in interactive and engaging ways. This event naturally attracts significant interest from the public and the media.

The Institute also participated in Science and Technology Week at the exhibition INCHEBA – EXPO Bratislava, 2012. All activities were organised by a council of young employees of Institute with the participation of other workers.

Also worthy of mention are the seminars in chemistry, biology and natural sciences for students of primary and secondary schools, organised annually as part of a national project by S. Kedžuch from IIC. Over 5000 students from elementary and secondary schools were involved in each year of the first stage (2012-2013). The seminars were followed by three specialised workshops over the summer for the best students.

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

2.8.1. Summary table of personnel

Personnel	2012	2013	2014	2015
All personnel	89.0	90.0	95.0	75.0
Research employees from Tab. Research staff	66.0	66.0	68.0	55.0
FTE from Tab. Research staff	49.390	49.280	57.950	45.470
Average age of research employees with university degree	42.7	43.3	43.5	44.1

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

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

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

MALE	AGE								
Number of	< 30	31 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 64	> 65
DrSc. / prof.					1	1	1	5	
II.a / Assoc. prof.			1	8		1	1	3	
Other researchers PhD./CSc.	3	3	6	7		1	2	4	
doc. / Assoc. prof.				3		2	1	1	

2.8.2. Postdoctoral and mobility scheme

2.8.2.1. Postdoctoral positions supported by national and international resources

Within Program for Human Potential Support in R&D and Science Popularization

[1] Modern application of fluoride molten salts, LPP-0345-09, doc. Ing. M. Boča, DrSc., 09/2009 - 08/2012

[2] Luminescence of silicon oxynitrides and nitrides prepared via organometallic precursors, LPP-0394-09, prof. RNDr. Pavol Šajgalík, DrSc., 09/2009 - 08/2012

2.8.2.2. Postdoctoral positions supported by external funding

2.8.2.3. SAS stipends and SASPRO stipends

HITEMPCORR - High-temperature properties of materials corrosion in molten salts**, 11/2015** - 11/2016, No: 1119/02/02, coordinator IIC: M. Boča, aplicant: Dr. Niketan Sarabhai Patel, India

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

Mgr. Stanislav Kedžuch, PhD. (2008 - 2012)

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

The infrastructure of the Institute has been systematically modernized with top instruments purchased under projects of the EU Structural Funds in which the Institute is involved as a principal investigator or partner. The majority of them were obtained within EU projects in which the universities were involved as partners. The instruments are located either in Bratislava or in Trenčín (department of VILA) and are available not only for IIC project partners but also for researchers from other insitutions.

The selection of instruments reflects the research topics of the IIC defined in national and international projects. The modern infrastructure has allowed a successful solving of the scientific tasks, which cover a wide range of research categories: i) spectroscopy, ii) physico-chemical and thermo-chemical analysis, iii) preparation of ceramic, glass and other inorganic materials, and iv) characterisation of materials. The most important and unique parameters of selected equipment are described in more detail below.

i) Equipment for spectroscopy

Spectroscopic research covers analysis of samples based on data obtained through absorption and emission of electromagnetic radiation in the UV, visible and IR regions. Relevant infrastructure includes high-performance absorption, fluorescence and infrared spectrophotometers fitted for the characterisation of all types of samples.

The universal absorption spectrophotometer Cary 5000, (Varian Inc., efficient spectral range 175 – 3300 nm) is a modular system able to measure in both transmission and diffuse-reflective modes. A remote probe is available to measure spectra of samples too large to be inserted into the equipment. The facility is equipped with a UMA module capable of measuring diffusely-reflected light under various angles; thus, in addition to the spectra, information on layer thickness can also be obtained. This configuration makes this spectrometer unique in Slovakia.

The fluorescence spectrophotometer Fluorolog-3 (HORIBA Jobin IVON) is a flexible system measuring luminescence properties of substances. This highly sensitive device can measure the fluorescence and phosphorescence spectra in the emission and excitation mode individually or synchronously using 3D analysis. The device is equipped to study kinetics using the titrator and stop-flow technique, quantum yields, etc.

The FTIR spectrometer Nicolet 6700 (Thermo Scientific) is suitable for qualitative and quantitative analysis of a broad spectrum of samples. In addition to conventional transmission techniques, Smart Accessories for reflectance techniques including Orbit diamond single bounce ATR (attenuated total reflection), Specular ATR, Diffuse Reflectance, and Near-IR UpDRIFT are available. Environmental chambers allowing experiments under controlled temperature (up to 900 °C) and/or under controlled gaseous atmosphere (for measurements of highly reactive samples) are also available.

Raman micro-spectrometer (Renishaw InVia) offers possibility of Raman spectra measurements at temperatures up to 1500°C. The sampling set contains FT-IR module, Leica DM 2500 microscope (confocal measurements), and excitation laser sources: Argon laser and HeNe laser and two heating stages (196-600°C, up to 1500°C).

ii) Equipment for physico-chemical and thermo-chemical analysis

The infrastructure for physico-chemical and thermo-chemical analysis combines high quality instrumentation for investigation of materials with specially-developed and -constructed furnaces for measurements of the phase equilibria, density, viscosity, surface tension and electrical conductivity of molten systems.

The high-temperature simultaneous thermal analyser STA 449 F1 and F3 Jupiter® (NETZSCH Gerätebau GmbH, Germany) offers the following: thermogravimetric analysis (TG), differential scanning calorimetry (DSC), differential thermal analysis (DTA) and measurement of thermal capacities (c_p). Depending on the selected mode and type of furnace, the equipment can operate at up to 2000 °C under controlled atmosphere (N_2, Ar, He, air) and vacuum. The device is additionally equipped with parallel QMS and FT-IR coupling for analysis of reaction/decomposition products formed during the thermal treatment of investigated systems. Such a complex device is unique in Slovakia or Central Europe.

The Thermomechanical Analyser Netzsch TMA 402 F1 Hyperion allows the measurement of thermomechanical properties during heating or cooling under controlled atmosphere or vacuum at up to 1650°C.

The Laser Flash apparatus (LFA 1000, Linseis) provides determination of thermal diffusivity, conductivity and specific heat values of materials up to 1600 °C.

iii) Equipment for preparation of ceramics, glass and other samples

Research infrastructure for preparation of different samples comprises laboratory furnaces for preparation, sintering and synthesis of materials at high temperature and pressure.
Hot isostatic press - HIP 200-110*200Gl (EPSI Ltd.) for the densification of powders, e.g. metals and/or ceramics, at temperatures up to 2000 °C and at pressures up to 200 MPa. Pressure is applied either by air or by inert gas (e.g. argon or nitrogen) and acts isostatically during the densification of the material.
Rapid/Direct hot press - DSP507; (Dr. Fritsch GmbH) for the densification of powders, e.g. metals and/or ceramics, at temperatures up to 2000 °C, load 30-50 MPa and heating rates up to 150 °C/min.

Continuous graphite furnace FCW 70/210-6-1900-PS/SP (FCT) for sintering of ceramic samples under controlled inert atmosphere up to 1900 °C.

Pressure autoclave, type: Büchi Glas Uster / Limbo li – a device for high pressure reactions e.g. chemical synthesis under supercritical conditions, as well as for studying the corrosion resistance of materials under hydrothermal conditions in an acidic or alkaline environment.

iv) Equipment for materials characterisation

The infrastructure of equipment for characterisation of materials comprises optical and diffraction devices and other equipment necessary for special analysis of materials prepared at the Institute.

The scanning electron microscope, type: JEOL JSM-7600 F/EDS/WDS/EBSD, designed for detailed chemical and microstructural analysis of materials, gives an image resolution as low as 1-2 nm at acceleration voltage 15kV, and 2-4 nm at 1kV. The SEM is equipped with such analytical modules as a WDS detector, SDD detector, and EBSD detector, as well as database software for evaluation of EBSD spectra.

The X-ray diffractometer Panalytical Empyrean DY1098 provides qualitative and semi-quantitative analysis of material phase composition, measurements of glass crystallization kinetics at high temperatures up to 1650°C, observation of crystallization defects in glass, thin film analysis and reflectometry, and thin film voltage analysis.

ICP OES (type: 5100 SVDV ICP OES), Agilent 7900 ICP-MS/LSX-213 G2+Nd: YAG Laser Ablation System, MS-ICP spectrometer and Dionex TM ICS-5000 system for chemical analysis.

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

In the evaluation protocol of the SAS scientific organisation for the previous assessment period 2007-2013, the following tasks were recommended:

Comments on and objections to organization´s activities in form of suggestions and specific tasks which must be performed by organization before the next regular evaluation:

1) The organization should continue increasing the quality of research results and educating new PhD students.
2) The management should identify potential candidates to increase the number of DrSc's in order to ensure the continuation of PhD programs at the Institute.
3) Funding of the current EU FP projects is rather low, so we encourage management to be more active in this respect.
4) The Institute has a lot of potential to get more funding from industrial partners, so we suggest to be more active in this field and initiate transfer of technologies to SMEs.

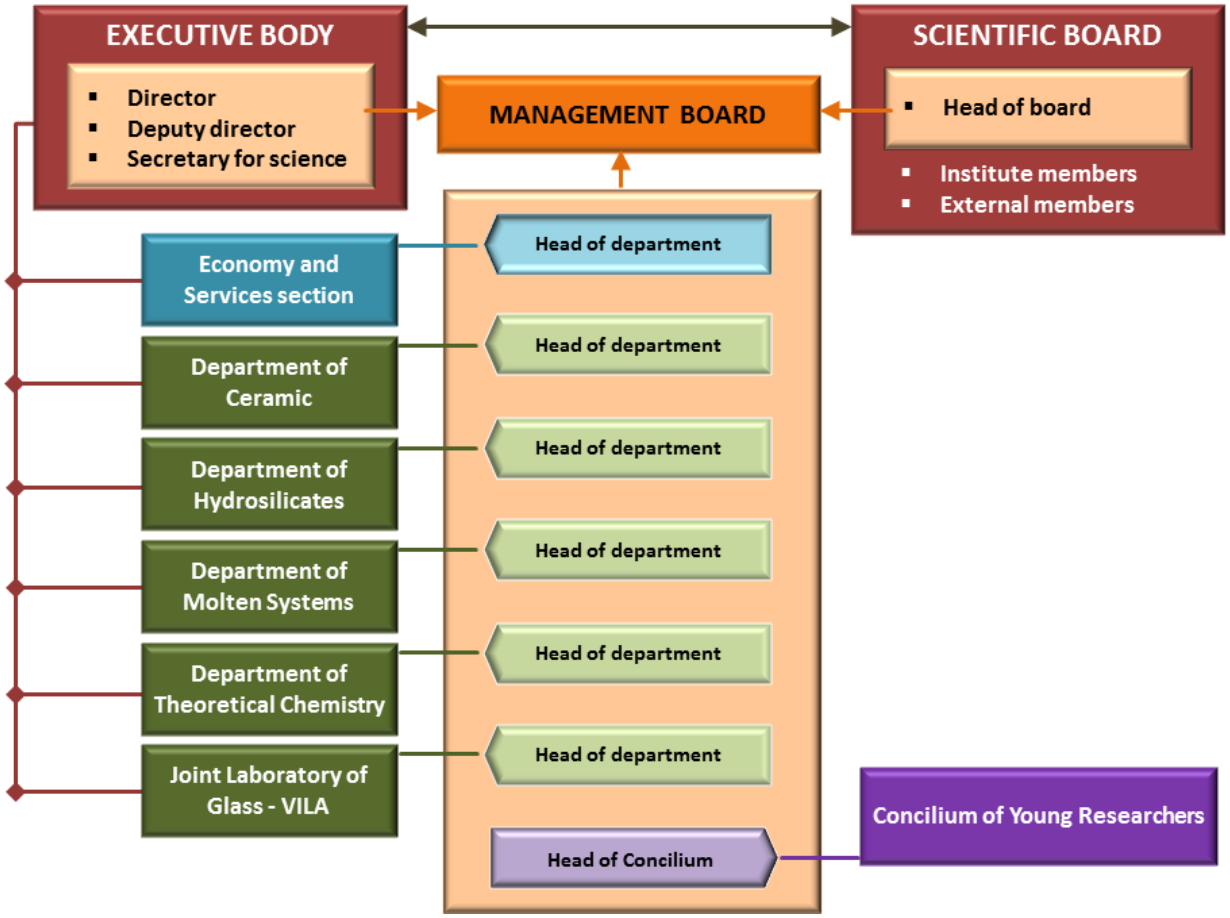
The following measures for fulfilloing the above recommendations were implemented:

1) In order to increase the quality of research results, a new system of scientific results evaluation was established. The scientific board, together with the executive bodies of the Institute, annually collate statistics on the number and quality of outputs of each department separately. Heads of the departments provide the analysis of the results as well as the strategy for next year, including issues of personnel, funding and research objectives.
2) A series of scientific and "self-education" presentations was established in order to increase the involvement of PhD. students in the career development process. These presentations take place every second week. PhD. students are also encouraged to spend some time (from one month up to 6 months) in foreign laboratories in order to learn new methods, get new ideas, create new contacts, and improve their communications skills.
3) One employee obtained a DrSc. degree during the assessed period (D. Galusek) and two more employees are identified as candidates for a DrSc. degree. Thus it seems that the conditions for a stable PhD program are in place.
4) The Institute significantly increased its efforts to join EU FP projects over the assessment period. Proposals for four H2020 projects were submitted (two of them as coordinator), as well as one ERC project and two Marie Curie fellowships where the Institute serves a partner organisation. The Institute was also successful in the SASPRO project (managed by the SAS presidency); three fellowships were awarded to the Institute.
5) In order to increase the chances of joining EU FP activities, Dr. Boča become a member of the Steering Committee of the European technology platform EuMaT - European Technology Platform for Advanced Engineering Materials and Technologies. Activities in this platform comprise active involvement in suggestion of topics for H2020 calls for projects as well as communication with the largest and most important industrial stockholders. This information is then communicated with national industrial partners and activities were carried out for creation of potential consortia for application of projects within the H2020 scheme. The companies Rona a.s., Lednické Rovne (manufacturers of high quality glassworks), VUEZ a.s. (an engineering, manufacturing, and installation company active in the energy industry), SMZ a.s. Jalšava (the biggest mining and processing magnesite plant in Slovakia) were involved in the above activities.

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

Management:

Organisation structure of the IIC SAS:



Management of the Institute is well-defined and well-performed. This has been documented by the results of many inspections (several per year) from different inspection bodies which found no serious deficiencies. This result is remarkable, as the administration associated with structural funds is enormous. However, to attain such a problem-free status many researchers are involved in administration and coping with significant workloads as a result (they are involved e.g. in public tenders or in explanations of unqualified questions from research agencies). Moreover, one or two positions are actually occupied by non-scientific staff at the expense of scientific staff. In order to involve young colleagues in the management activities a special body operates at the Institute – the Concilium of Young Scientists. Their representative actively participates in the weekly management meetings and they solve some specific problems independently with full responsibility (such as PR management of the Institute, and activities like Open Doors Day and Researchers' night).

Research infrastructure: Within the assessment period, the infrastructure development (due to structural funds) started in the previous period continued. The strategy was to widen the

operational options of existing equipment as well as to supply the most expensive parts of the equipment.

Personnel development: This topic is the most important issue for the development of the Institute. Many details are discussed in appropriate places in several chapters above. The key issue remains of providing conditions for further career development of all researchers. These issues are e.g motivation for self-education, motivation to create new contacts providing exchange of experiences and new ideas as well as integration into the international research scene, and presenting our results to leading consortia. Due to the luck of graduate students from the field of inorganic chemistry in Slovakia, we would like to attract PhD students and post-docs from foreign countries to join the Institute as well.

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

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

The orientation of research at the Institute is consistent with the general mission declared in the Foundation Charter. Research activities of the individual departments are in line with the relevant parts of the Charter in their choice of topics. The Institute's orientation towards the materials research is fully in agreement with the state research policy of Slovakia (including the research and innovation strategy defined in RIS3) and in line with current trends in global research. Functional materials and progressive technologies are among the most important research directions supported by national research agencies in Slovakia. A short overview of the state of research for particular departments follows:

Department of Molten Systems: Presently, the research activities of the Department are focused on all the major areas of fluoride system research: i) research of melts for production of metals (such as Al, Ta, Nb, Zr or Mg), ii) research of melts for cooling or heat transport in 4th generation nuclear power plants (the Department participates in the ALEGRO project for nuclear reactor testing), iii) research into different molten systems for accumulation of solar heat energy. The latter topic is the most common research activity within the field of investigation of molten salts. Research into the various applications of molten salts is experiencing a broad recovery after a decade of stagnation. This renaissance is mostly occurring in the USA and Asian countries (particularly China) with the support of their national governments. Out of almost 12,000 publications dealing with molten salts over the years 2005-2015, only ca. 1,700 were from Europe (at least one author/co-author). Of these, our Department participated in ca. 80 papers. This is comparable to any other remaining research group in Europe of the same size. Korenko and Boča are among the top 100 authors of these European publications. Because of the decline of leading molten salts organisations in Europe it becomes slightly difficult to build up collaborations with our nearest academic neighbours, and the department must focus more on academic partners in America or Asia or industrial partners in Europe. Keeping up contact with these partners is essential for the further scientific growth of the Department as a relatively wide area of applications is dependent on the topics discussed above. Moreover, fundamental research in molten salts is starting to be concentrated in facilities using synchrotron radiation for e.g. examination of molten salts' "structure". Another reason for the shrinking number of high temperature molten salt research groups in Europe is the fact that many groups have shifted their research activities to low temperature ionic liquids. These can be used for special applications but cannot be used for large

scale ones. Finally, the situation in recent decades has produced little in the way of basic thermodynamic experimental data.

Personnel-wise, the Department of Molten Systems is the biggest group dealing with molten salts in Slovakia (although one research group at the Slovak University of Technology is oriented towards some complementary electrochemical methods dealing with molten salts).

Ceramic Department: the Ceramic Department has reached a respectable position in the field of advanced ceramics in the ERA. Since the 5th FP EU program, the CD has regularly participated in European projects and built up a good network of partners and contacts, including well-known research institutes from Germany, Italy, Sweden, France, and elsewhere. The CD has organized a successful International Workshop on Engineering Ceramics since 1989 and the last (the 8th in succession) was organized in Smolenice castle, Slovakia in 2015. Selected papers from the workshop were published in a special issue of the Journal of the European Ceramic Society (Volume 36, Issue 12, Pages 2855-3072, September 2016). The special issues of the JECerS from the Engineering Ceramics workshop belong to the highest-cited issues of the journal. The Engineering Ceramics workshop is one of a series of workshops/conferences on nonoxide ceramics organized worldwide. Once every a four years there are also organized the conferences Silicon Based Ceramics (Korea), SiAlONs and Similar Ceramic Materials (Japan) and International Symposium on SiAlONs and Non-oxides (Europe).

Members of the Ceramic Department (Pavol Šajgalík and Zoltán Lenčéš) are frequently invited to the Organizing Committees and International Advisory Boards of international conferences and symposia, and have presented many invited talks and some plenary talks at major conferences (see attached list).

In the Ceramic Department several foreign PhD students have finished their PhD thesis (Germany, Austria, Czech Republic, Egypt) and young post-docs from USA, Japan, Italy, Germany have spent several months at the Department.

The Head of the Department, Professor Pavol Šajgalík, presently serves as president of the European Ceramic Society as well as president of the Slovak Silicate Society. He has received several international awards: the Stujits award of the ECerS, an Honorary doctorate from the Pardubice University of Technology, an Honorary doctorate from the Technical University of Ostrava, the Lee Hsun Lecture Award on Materials Science from the Institute of Materials Research of the Chinese Academy of Sciences, an adjunct professorship from North Western Polytechnic University in Xi´An, and others.

The publications of the Ceramic Department appear in some of the top journals in the field of ceramics – the Journal of the European Ceramic Society, the Journal of the American Ceramic Society, and Ceramics International.

Department of Hydrosilicates: Research on hybrid systems based on organic dyes and layered silicates requires a very complex and interdisciplinary approach, combining knowledge in photochemistry, photophysics, the chemistry of hybrid materials and the formation of supramolecular systems, the chemistry of colloids and surfaces, synthesis of nanomaterials, etc. Several research institutes collaborate with our group, mainly in the EU and Japan. Our partners are often focused on specific aspects of photochemistry, such as non-linear optical properties, or are researching the certain types of organic dyes, etc. The main contribution of the team has been in understanding the influence of inorganic template particles on the photophysical properties of organic dyes in the hybrid materials. This approach is unique worldwide. Specifically, chief contribution is in the inorganic template-controlled formation of dye supramolecular assemblies, understanding of the basic rules to design suitable hybrid materials of desired optical properties, predicting of which silicate carrier to choose for specific type of hybrid material and which surface modification should be carried out to fit to specific material properties or applications. Other line of

research at the department is directed to the research of clay-polymer nanocomposites, which is a hot research topic with 540 records in Web of Science in 2015. These materials require extensive knowledge of smectite modified with organic cations, which alter the surface transforming it from hydrophilic to hydrophobic, and of polymer science to select an appropriate polymer matrix as the non-clay component. In contrast to other research groups examining mostly the commercially available surfactants, the investigation in the Department of Hydrosilicates is focused on the design and testing of organoclays based on unconventional, commercially inaccessible and/or newly synthesised surfactants. Collaboration with the Polymer Institute of the SAS in this field is an example of an effective national research within the SAS. The results have been published in a recognized international journal and a Patent application on polymer clay nanocomposites based on unconventional organic modifiers has been submitted recently (Slovak patent application PP 97-2015: Rubber compounds based on polymer compositions containing nanofillers. Authors: I. Chodák, Ľ. Jankovič, P. Komadel, D. Jochec – Mošková, M. Sedničková). The members of the Department of Hydrosilicates have reached several international recognitions. Head of the department, P. Komadel was in 2010 - 2014 a member of the Executive Committee of the Clay Mineral Society based in USA, in 2012 - 2013 he was the President of The Clay Minerals Society. This society covers various activities connected with clays and clay minerals worldwide. In 2011 - 2015 he was the President of the Association of the European Clay Groups. J. Bujdák received the first ever Gerhard-Lagaly-Award of the German-Austrian-Swiss Clay Group as an internationally excellent scientist with outstanding original research in the field of clay mineralogy. This is a "midcareer award" with an age limit of the awarder between 40 and 55 years at the time of nomination. The PhD students of the department have been frequently among the awarded young scientists within the students competitions held at international clay conferences.

Department of Theoretical Chemistry: The development of relativistic quantum-chemical methods and computer programs for the calculation and interpretation of NMR and EPR parameters for compounds containing heavy elements plays an important role in our Department, an area of quantum chemistry which finds frequent application in basic research into biologically important compounds, new drugs development, catalysis in environmental sciences, development of new materials, and nuclear wastes treatment. NMR and EPR spectroscopic parameters are very sensitive to the electronic structure in the immediate proximity of the nuclei, and are hence very sensitive to relativistic effects. Therefore, special quantum chemical methods and programs are required for suitable theoretical calculations and interpretation of the spectra. The fully relativistic 4-component approach for calculations of NMR parameters based on the restricted magnetically balance basis, which our Dpeartment has developed, is among the best-known methods in the world and is used in many foreign scientific groups. A significant part of our departmental activity is the development and maintenance of ReSpect, the computer program performing these calculations.

Progress in simulation methods used to solve the problem of the deficiency of long-range dispersion interactions within mean-field theories such as DFT represents a very active and highly relevant field of theoretical research. This fact can be seen from the rapidly growing number of references to terms such as “dispersion correction” in the literature, growing from a few dozen in 2000 to well over ten thousand in 2015. Our activities related to this topic include development and implementation of new physical models for dispersion energy calculations in the solid state and systematic benchmarking of their performance. WMost of the methods have been implemented by us in the widely used periodic DFT program VASP, used the world over as the *de facto* standard software for materials science simulations. Implementation into this major simulation software not only makes for publications in international scientific journals, but provides an important platform for dissemination of research ideas. Our research is done in close collaboration with renowned researchers from Austria, France, Australia, and elsewhere, and vital contacts with groups in other countries (e.g. Luxembourg and Czech Republic) have also been established. As evident from the

ever-growing number of citations (over 500 WoS citations of our crucial papers), our research results have attracted significant attention from the wider scientific community.

Density fitting represents nowadays a powerful technique for speeding up a large variety of electronic structure calculations. While on the molecular level it has already become something of a standard tool, in our department we were among the first who addressed the problem of density fitting in infinite systems with translational periodicity and made several significant contributions to both the Coulomb and exchange parts of the problem.

Methods aimed at achieving spectroscopic accuracy in *ab initio* calculations of molecular properties are still rare and, moreover, limited to very small systems. Our long term effort in the development of such methods has been focused on proper treatment of the electron correlation (many-body effects), which is crucial for achieving the desired predictive power. The group working in this field is globally respected, which can be seen during the assessment period by the various invited lectures at prominent international conferences and the election of the group leader (J. Noga) as a member of the International Academy of Quantum Molecular Sciences.

Joint Glass Centre Vitrum Laugaricio (VILA): The Joint Glass Centre Vitrum Laugaricio (VILA), located in Trenčín, Slovakia, is a joint venture of three Slovak academic institutions, the Institute of Inorganic Chemistry, Slovak Academy of Sciences, Bratislava (IIC), Alexander Dubček University of Trenčín (TnUAD), and the Slovak University of Technology, Bratislava (STU). As such, it represents one of the leaders in the Slovak Republic in the field of inorganic non-metallic materials, with special attention paid to glass and ceramics. The research topics pursued in VILA are outlined in section 1.8, and represent a strong foundation for domestic and international collaboration both with academic partners and with industry. In recent years the VILA has been successful in obtaining a significant amount of funding from the European Regional Development Fund (ERDF) and other sources (including industrial partnerships). As a result of these activities, the centre has at its disposal an up-to-date research infrastructure constructed so as to enable the whole range of research and experimental activities necessary, from preparation of samples to their basic and advanced characterisation in terms of their microstructure, chemical and phase composition, and physical properties, including mechanical, thermal, optical, and spectral. The VILA can be considered a technological leader in the field of glass, ceramic and silicate materials in the Trenčín region where it is located, and belongs to the most influential materials research laboratories in the Slovak Republic. The status of the centre has been achieved through high quality research outputs in internationally recognised scientific journals, a high success rate in research projects funded both from domestic (grant agencies VEGA and APVV) and international (NATO SfP, Humboldt foundation, JECS Trust) sources both in fundamental and applied research, intensive collaboration with regional industrial partners, and intensive education and training of qualified researchers. The Centre publishes on average 14 peer-reviewed scientific papers annually in its area of interest. The research activities of VILA are carried out mainly on the basis of national research projects funded through the Slovak Research and Development Agency (APVV) and the Research Grant Agency (VEGA). On average 6 national projects are completed yearly by the researchers from VILA. Growth of international cooperation with educational and research institutions abroad is ensured through various international multilateral activities, e.g. bilateral projects with the Czech Republic, Germany (ceramic coatings with glass fillers for high-temperature corrosion protection of metals, University of Bayreuth), Taiwan (new rare earth-free inorganic phosphors for energy saving lighting applications, and transparent oxide ceramics with additional optical functionalities, both with National Taiwan University, Taipei), and France (chemical durability, ageing and mechanical properties of zirconia-based dental ceramics, University of Lyon). The centre has intensive scientific collaboration with a range of long-term industrial partners in the region (the cross-border region at the Slovak-Czech border where the Centre is located is referred to as the Euroregion of Glass), e.g. RONA, a.s. Lednické Rovne; Johns Manville Slovakia, a.s., Vetropack Nemšová,

s.r.o., VUEZ, a.s. Levice, Glass Service Vsetín, and others. Through its partner, TNUAD, the centre currently provides training and education in two study programmes, a Masters programme in Chemistry and Technology of Inorganic Materials and Glass, and a PhD programme in Inorganic Technologies and Non-metallic Materials. On average 3 or 4 new PhD students are enlisted for the PhD study programme in VILA every year.

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

The research strategy of the organisation must primarily arise from the main objectives of the Institute. These objectives must be realistic and must be feasible. Further, the measures to reach the objectives must reflect the actual internal or external conditions (often obstacles), which can and will change with time. The main objectives of the Institute can be defined as follows:

- We want to be a dignified and respectable research partner for national and international partners both academic and industrial.
- We want to participate in the further development of those scientific fields which the Institute was established for and has accumulated significant experience in.
- We want to be a part of the interdisciplinary scientific community that is looking for solutions to current problems.

These aims are not modest, but the progress of the Institute within the last assessment period encourages us to hold such a challenging vision.

As can be seen from the state of research described by the individual departments, the Institute is aware of its position in the international research area as well as of its weaker aspects that must be strengthened. Some measures have already been initiated (e.g. those described in 2.8.4). The involvement of the Institute within Horizon 2020 is not satisfactory, although as indicated in the table below, there has been activity in preparation and submission of proposals, including the formation of consortia in which the Institute served as the coordinator. The recently submitted project, now in the second stage, with the title “Building-up Centre of Excellence for advanced materials application (CEMEA)”, coordinated by the Slovak Academy of Sciences Presidium, is an expression of the ambition of the Institute (as a partner of this project) to have much closer collaboration with the relevant industry in Europe as well as in Slovakia. This project was successful in its first stage within the scheme TEAMING. Within this scheme the Institute is indirectly engaged as well with a second project “Centre for functional and surface functionalized glasses”, obtained through Alexander Dubček University of Trenčín as a partner in the Joint Glass Centre Vitrum Laugaricio.

Project proposals submited to 7RP or H2020	2012	2013	2014	2015
Institute as coordinator	0	0	0	2
Institute as participant	2	0	1	4

Involvement of the Institute in the H2020 projects is indeed one but not the only one indicator of the Institute’s position in ERA. However, activities in this area will continue.

Additionally, the following measures are planned in order to attain the aims defined above.

1. Progressive management of human resources

- To focus attention on the career development of all categories of scientists, starting from PhD. students up to senior researchers.
- To encourage colleagues to create new contacts and go for both short and longer stays in laboratories abroad.
- To maintain an acceptable average age.
- To maintain the continuous training of the staff, including PhD students, in new methods and new research fields.

2. The following research areas are to be a primary focus:

- Materials for energy applications – research activities across all departments including ceramic materials for lighting and new types of batteries, corrosion tests in highly aggressive molten fluorides.
- Biomaterials / Materials for health care – mostly ceramic biomaterials and clay-based hybrid materials with antibacterial properties
- New technologies - ceramic technology for the preparation of the materials for extreme environments.
- Domestic raw materials - exploitation of the 1) magnesite for the new applications, 2) inorganic waste, 3) clay minerals modified with specific organic surfactants for polymer clay nanocomposites.
- Other functional materials - like optical materials, including materials with luminescence properties, materials with electric or magnetic properties or structural glass-based materials, hybrid systems based on organic dyes and layered silicates.

The research focus of the Institute for next period well document new projects approved by the Slovak Research and Development Agency (APVV) for 2016-2020 (list of the project is given in session 4).

3. Cooperation, projects

- To increase the Institute's participation in large international projects financed from the European Commission or other sources outside Slovakia.
- To support creation of domestic and international interdisciplinary research consortia.
- To find methods and funding to accept post-docs from abroad.
- To increase involvement in the research with industrial partners.
- To continuously increase the quality of publications.

4. Infrastructure

- To develop and upgrade our infrastructure in order to have laboratories providing both standard and specialised services.

The above intended measures define the research strategy of the Institute in the national and the international context. However, one important fact has not been mentioned till now. While each department solves certain specific problems, strong cooperation between departments is essential for the Institute's success. It must be emphasised that significant effort is put into ensuring cooperation between Institute departments. The departments participate together in joint projects both academic and industrial, have joint publications, and some specific measurement services performed by particular departments are provided for all researchers of the Institute.

It is essentially impossible to provide an exact time schedule for these strategies, as they strongly depend on governmental budget and other external impacts. Nevertheless, we firmly intend to reach the defined aims and we hope they will be achieved during the next four years' evaluation period, at least to a substantial extent.

4. Other information relevant for the assessment

List of approved projects APVV from General Call in 2015

[1] Assessment of secondary raw materials for the preparation of materials used in extreme conditions, APVV-15-0540, Coordinating organization: IIC, coordinator: doc. Ing. Miroslav Hnatko, PhD.
[2] Fluoride melts of critical elements for unconventional applications, APVV-15-0479, Coordinating organization: IIC, coordinator: doc. Ing. Miroslav Boča, DrSc.
[3] Nanocomposite materials based on organo-phosphonium smectites and polymers, APVV-15-0741, Coordinating organization: IIC, coordinator: RNDr. Peter Komadel, DrSc., Partner: Polymer Institute SAS
[4] The behaviour of new progressive construction materials in aggressive environment of molten salts, APVV-15-0738, Coordinating organization: IIC, coordinator: Ing. František Šimko, PhD. Partner: Institute of Physics SAS
[5] Developing new theoretical tools for prediction and interpretation of EPR and NMR parameters, APVV-15-0726, Coordinating organization: IIC, coordinator: Dr. Vladimír Malkin, DrSc., Partner: Institute of Chemistry SAS
[6] Advanced composite coatings for high temperature corrosion protection of metals, APVV-15-0014, Coordinating organization: IIC, coordinator: prof. Ing. Dušan Galusek, DrSc., Partners: Alexander Dubcek University of Trencin, Institute of Materials Research SAS
[7] Ceramic materials for extreme operating conditions, APVV-15-0469, Coordinating organization: Institute of Materials Research SAS, IIC coordinator: prof. RNDr. Pavol Šajgalík, DrSc.
[8] Prevention and eradication of microbial biofilms in relationships to nanomaterials, APVV-15-0347, Coordinating organization: Faculty of Natural Sciences, Comenius University in Bratislava, ICC coordinator: RNDr. Juraj Bujdák, DrSc.
[9] Heterocycles for progressive trends of the century, APVV-15-0589, Coordinating organization: Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava, ICC coordinator: RNDr. Ľubomír Smrčok, CSc.

Cooperation with industrial partners in Slovakia
RONA, a.s., Lednické Rovne – glass production company
GoldenSUN Slovakia, s.r.o., Liptovský Mikuláš
VUEZ, a.s., Levice - engineering, manufacturing, and installation company
Johns Manville Slovakia, a.s., Trnava - - building and special materials industry
PORFIX - pórobetón, a.s. Zemianske Kostoľany – building industry
Považská cementáreň Ladce, a.s., Ladce - cement production
Geothermal Anywhere, s.r.o., Bratislava
RF, s.r.o., Malacky
CEIT Technical Innovation, s.r.o. - member of CEIT group, Žilina
OFZ, a.s., Istebné - diversified manufacturer of ferroalloys
Slovenské magnezitové závody, a.s., Jelšava - mining and manufacturing magnesite plant
VUJE, a.s., Trnava, engineering company in the field of nuclear and conventional power generation

VETROPACK NEMŠOVÁ s.r.o., Nemšová - container glass manufacturer
Výskumný ústav zváračský - Priemyselný inštitút SR z. z. p. o. – welding research institute
Zväz sklárskeho priemyslu SR, Lednické Rovne – glass industry association
LEONI Slovakia, spol. s r.o. Trenčín- world-renowned manufacturer of insulated wires, cables for the electrical industry, based in Germany
Slovalco, a.s. Žiar nad Hronom - aluminium production
Water Research Institute (WRI) Výskumný ústav vodného hospodárstva, Bratislava
LB Minerals, a.s., Košice - a group member Lasselsberger, supplier of mineral resources
BEKAERT Hlohovec, a.s. - steel wire transformation and coating technologies
Železničná spoločnosť Slovensko, a.s. – Slovakian state railway company
ACO Stavebné prvky s.r.o., Bratislava - member of ACO Group (components for the construction industry)

Cooperation with research institutions and universities in Slovakia
Faculty of Mathematics, Physics and Informatics, Comenius University
Institute of Nuclear and Physical Engineering, Faculty of electrical engineering and information technology, Slovak University of Technology, Bratislava
Department of Geology of Mineral Deposits, Faculty of Natural Sciences, Comenius University, Bratislava
Faculty of Natural Sciences, University of Matej Bel, Banská Bystrica
Faculty of Chemical and Food Technology, Slovak University of Technology, Bratislava
Faculty of Metallurgy, The Technical University of Košice
The Alexander Dubček University of Trenčín
Faculty of Industrial Technologies in Púchov
Faculty of Medicine, Comenius University, Bratislava
Polymer Institute SAS, Bratislava
Institute of Materials and Machine Mechanics SAS, Bratislava
Institute of Virology BMC SAS, Bratislava
Institute of Electrical Engineering SAS, Bratislava

Cooperation with industrial partners abroad
GLASS SERVICE, Inc., Vsetín, Czech Republic - the field of glass melting, conditioning and forming
Aerospace & Advanced Composites GmbH., Austria - research, development and engineering of materials, technology and testing
RHP Technology GmbH, Austria
RHI AG, Technology Center, Standort Leoben, Austria - supplier of high-grade refractory products, systems and services for industrial high-temperature processes exceeding 1,200°C
ALCOA - Primary Metals, USA - producer of primary aluminum
BERTIN Technologies, France
AREVA, GmbH, France - products and services to support the operation of the global nuclear fleet (AREVA NP - Slovakia)
Alion Science and Technology, USA
UMICORE, Belgium - global materials technology and recycling group
CROmed, Hungary
IRSN Institut de radioprotection et de sûreté nucléaire, France - establishment for investigations, expertise assessements and studies on the fields of nuclear safety, protection against ionizing radiation, protection and control of nuclear material, and protection against voluntary ill-advised acts
Ústav jadrového výskumu Řež Inc., Czech Republic - safety, reliability and efficiency support for nuclear and conventional power plant operations and heating stations
OSRAM, Germany
OFI, GmbH., Austria - materials technology, building industries, automotive engineering, packaging

Adjuvatix, Ltd, Hungary
ITM Kft., Hungary
Lithoz, GmbH., Austria - development and production of ceramic materials and additive manufacturing systems (3D printing), ceramic prototypes, small scale series and complex parts
Nanocolltech, Ltd., Hungary
Faurecia, GmbH, Germany, automotive industry

Cooperation with research institutions and universities in abroad
Brno University of Technology, Czech Republic
Observatoire de Grenoble, Universite Joseph Fourier, Grenoble, France
National Institute for Materials Science, Tsukuba, Japan
Technische Universität Darmstadt, Darmstadt, Germany
Montan Universität, Leoben, Austria
Chalmers University of Technology, Göteborg, Sweden
Department of Material Science and Engineering, National Cheng Kung University, Taiwan
Institute for Ceramic Technology, ISTEC, Faenza, Italy
University of Illinois, Champaign-Urbana, USA
Conditions Extremes et Materiaux: Haute Temperature et Irradiation, CNRS, France
Valparaiso University, Valparaiso, USA
Interdisciplinary Graduate School of Science and Engineering, Shimane University, Matsue, Japan
Institute of Inorganic Chemistry of the AS CR, V.V.I., Czech Republic
Jerzy Haber Institute of Catalysis and Surface Chemistry, Polish Academy of Sciences, Krakow, Poland
Fraunhofer Institute for Ceramic Technologies and Systems, Germany
VŠB - Technical University of Ostrava, Czech Republic
Karlsruhe Institute of Technology, Germany
Monash University, Melbourne, Australia
Northeastern University, Shenyang, China
Northwestern University, XiAn, China
Universität Bayreuth, Germany
Semmelweis University, Orthopaedic Clinic, Budapest, Hungary
Univerzita Liberec, Czech Republic
Sheffield Hallam University, England
Universita di Padova, Dipartimento di Ingegneria Industriale, Italy
National Taiwan University, Taipei, Taiwan
University of chemistry and technology, Prague, Czech Republic
Otto-Schott Institut, Jena, Germany
Institute of Technical Thermodynamics DLR, Germany
Department of Materials Science and Engineering, Norwegian University of Science and Technology, Norway
University of Trento, Materials Science Department, Trento, Italy
University of Ghent, Department of Inorganic and Physical Chemistry, Belgium
Jožef Stefan Institute, Engineering Ceramics Department, Ljubljana, Slovenia
National Institute for Advanced Industrial, Science and Technology (AIST), Nagoya, Japan
Laboratoire de Génie Chimique, Université de Toulouse, France
Univerzita Pardubice, Czech Republic
Masarykova Univerzita Brno, Czech Republic
Austrian Research Center, Materials Science Division, Austria
University of Szeged, Hungary
TUBITAK Marmara Research Center, Materials Institute, Barış Mah, Turkey
Instituto de Ciencia deMateriales, Sevilla, Spain
Institute of Materials and Environmental Chemistry, Hungarian Academy of Sciences, Hungary
Instituto di Cerámica y Vidrio, Madrid, Spain

University of Novi Sad Faculty of Technology, Serbia
Fraunhofer Institut für Biomedizinische Technik, St. Ingbert, Germany
Materials Center, Leoben, Austria
Institute of Chemistry and Technology of Rare Elements and Mineral Raw Materials, Kola Science Centre RAS, Russia
Friedrich-Alexander Universität Erlangen-Nurnberg, Germany
University of Lyon, France
Tokyo Metropolitan University, Dept Appl Chem, Tokyo, Japan
University of Ioannina, Dept Mat Sci & Engn, Ioannina, Greece
University of Natural Resources and Applied Life Sciences, Vienna, Austria
German Research Centrum for Geosciences GFZ, Telegrafenberg, Potsdam, Germany
AGH University of Science and technology, Krakow, Poland
J. Heyrovský Institue of Physical Chemistry, Academy of Sciences of the Czech Republic, Czech Republic
Kobe University, Japan
Institute for Soil Research, University of Natural Resources and Life Sciences, Vienna, Austria
Fakultät für Physik, Universität Wien, Austria
Institute of Solid State Physics, Graz University of Technology, Austria
CNRS, CRM2, UMR 7036, Vandoeuvre-lès-Nancy, France
Department of General and Inorganic Chemistry, Pannon University, Hungary
Regional Centre of Advanced Technologies and Materials, Department of Physical Chemistry, Faculty of Science, Palacky University Olomouc, Czech Republic
Department of Chemical and Biomolecular Engineering, Lehigh University, USA
Qld Micro- and Nanotechnology Centre, Griffith University, Nathan, Australia
Institute of Physics of the Czech Academy of Sciences, Czech Republic
University of Geneve, Switzerland
Centro de Tecnología de Recursos Minerales y Cerámica (CETMIC), Centro Científico Tecnológico CONICET La Plata, Buenos Aires, Argentina