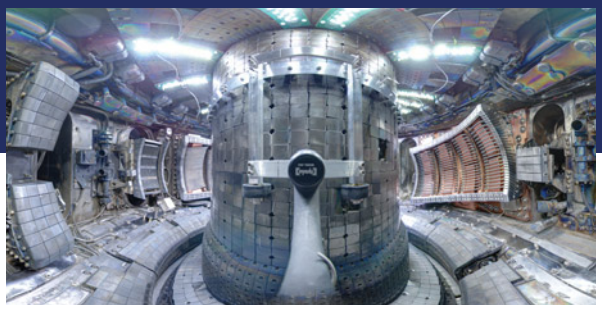
The Excellence Centre of Advanced Material Research and Technology Transfer







INSTITUTE OF SOLID STATE PHYSICS
UNIVERSITY OF LATVIA

CAMART²

PEN LOOKS AT THE TEAMING INSTRUMENT, FOCUSING IN ONE OF THE PROJECTS TO RECEIVE FUNDING UNDER THE WIDESPREAD-1-2014 CALL, CAMART^2

TEAMING up

IN 2015, the European Commission announced it would be providing new grants to help bridge the research excellence gap between member states and strengthen competitiveness and growth across Europe. This was to be done via the new Teaming instrument, which was designed to help improve research performance and increase investment in countries with lower research excellence rankings.

With funding from Horizon 2020, 31 projects from such countries were selected to prepare operational plans for new centres of excellence by teaming up with high-calibre institutions from all over Europe. The first Teaming projects selected for funding were led by research institutions or agencies as well as national or regional authorities, and phase one of this action saw projects receive up to €500,000 each (€14.5m in total) to prepare operational plans for new centres of excellence or for upgrading existing ones.

Speaking at the time, European Commissioner for Research, Science and Innovation Carlos Moedas said: "Put simply, we want Horizon 2020 funds to benefit as wide a range of European universities and research institutes as possible. We are determined to see that no part of Europe is left behind in research and innovation. Teaming now helps to achieve this by creating partnerships between those at the top and those with the most potential. Horizon 2020 rewards excellence and, most importantly, the pursuit of excellence."

In phase two, up to ten of these projects could then be selected for further support to implement the centre, following a competitive review process. The funding for the first step proposals (31 selected out of 169 submitted) reached €14.5m and around €87m was, in 2015, foreseen for phase two.

Carlos Moedas (Commissioner of Research, Science and Innovation)

Under Horizon 2020, the commission has said, a strong packet of measures with up to €800m was made available for widening participation of low-research performing member states. Such actions include Teaming, Twinning (institutional networking that includes support on staff exchanges, expert advice and assistance), as well as special awards like the new ERA Chairs instrument.

Widespread

Outlining the 'WIDESPREAD-1-2014' Teaming topic, the Commission has explained that 'Despite its strengths, the European Research and Innovation landscape presents a lot of structural disparities, with research and innovation excellence concentrated in a few geographical zones. These disparities are due to, among other reasons, the insufficient critical mass of science and centres having sufficient competence to engage countries and regions strategically in a path of innovative growth, building on newly developed capabilities. This could help countries and regions that are lagging behind in terms of research and innovation performance reclaim their competitive position in the global value chains. Teaming will address this challenge by creating or upgrading such centres of excellence, building on partnerships between leading scientific institutions and low performing partners that display the willingness to engage together for this purpose.'

The WIDESPREAD-1-2014 call therefore looked for projects able to lead to the creation of new (or significant upgrades of existing) centres of excellence in member states and regions currently identified as low performers in terms of research and innovation, increasing on the one hand their scientific capabilities and on the other, enabling them to engage in a strategic growth path in terms of economic development. It is also expected that improved scientific capabilities will allow them to improve their chances to seek competitive funding in international fora (including the EU framework programmes).

'Over the medium to long term there will be a measurable and significant improvement in the research and innovation culture (as shown through indicators such as research intensity, innovation performance, enhanced strategy, values and attitudes towards research and innovation) within member states currently with low R&I performance. These will be fostered through constructive and sustainable partnerships achieved between research and innovation-intensive institutions of excellence and the partnering organisation in the low performing member state or region. Benefits will also accrue to the institutions from the more intensive research and innovation performers, in terms of issues such as access to new research avenues, creativity and the development of new approaches, as well as a source for increased mobility (inwards and outwards) of qualified scientists.'

Official photo from the conference "Spreading Excellence and Crossing Innovation Divide", November 23, 2016 , Brussels: (from left) Peter Plavčan (Ministry of Education, Science, Research and Sport of the Slovak Republic), Andris Sternbergs (coordinator of CAMART² project) and Carlos Moedas (Commissioner of Research, Science and Innovation)

Crossing the divide

In November 2016, during the conference 'Spreading Excellence and Crossing the Innovation Divide' organised by the European Commission in Brussels, Commissioner Moedas, together with the Director-General of the Directorate-General for Research and Innovation, Robert-Jan Smits, announced the winners of the WIDESPREAD 1-2014: Teaming competition.

At the event, Moedas argued that "one of the major political and economic challenges all countries are facing today is growing inequalities," adding that a lack of diffusion of knowledge and technologies is the cause. "The new digital technologies are not diffusing. The knowledge is trapped in businesses that are investing in innovation. This lack of diffusion feeds inequality, which has a huge cost for all of us. It translates into wasted resources, wasted talent and wasted potential," he said. "Research and innovation is key to overcoming these gaps. We need to feed the pipeline of talent and ideas and help them diffuse far and wide. Ensuring excellence is present in all EU member states. Encouraging openness so that knowledge, ideas and people will flow."

For Moedas, the answer as to why some countries get more impact from their spending on research than other countries (and he was referring to both scientific and economic impact) lies in the national research and innovation systems: "They vary widely. So one of the first challenges for countries with low levels of excellence is to introduce reforms to their systems. This is never easy. It requires a good diagnosis of the system. It requires a process to reach agreement between the different actors. And it requires expertise and persistence to implement reforms.

"Then, of course, there is the varying degree of investment. But the newer member states have been given a big opportunity to build excellence. The European Structural and Investment Funds are putting €100bn into research and innovation. But to make sure these resources actually translate into progress, countries will need to connect the islands of excellence and network internationally.

"And perhaps most important of all, countries need to attract talent. The best researchers and innovators are internationally mobile. If countries are not able to offer attractive opportunities, the most talented will leave," the commissioner concluded.

After discussing the role of Horizon 2020, Moedas then outlined his intention to "beef up and optimise investments in excellence." He said: "Teaming actions have had an enormous impact, supporting the creation of new or upgraded centres of excellence in widening countries.

CAMART²

One of the ten projects to receive funding through the WIDESPREAD 1-2014: Teaming competition was CAMART², the biggest project in the history of Latvian science to date. This was launched at a ceremony attended by representatives of the European Commission, Latvian government officials, foreign co-operation partners and guests, as well as the orchestrators of the project, i.e. the employees of the Institute of Solid State Physics. The objective of the project is to strengthen the position of both the institute and the Latvian state within the European science sector through the development of the centre into a regional institution of European renown in the field of materials science and technology transfer.

Speaking at the launch, Robert-Jan Smits said: "The only way Europe can compete with the rest of the world is to be smarter than others and to prove itself in the field of innovation. This means that investments must be made in education, science and innovation development. Such investments must be made at national level, at regional level, and, of course, also at international level within the European Union. We are delighted to see that, in the face of stiff competition, this major project has been awarded not only Horizon 2020 funding, but has also received support from the Latvian government.

"The strengths of the CAMART² project are the high qualifications of the scientists involved and a strong plan for how to pass on this knowledge and experience, and how to encourage mutual collaboration between the academic and business sectors. This project has all the characteristics required to make it an exemplar: high level science, potential for innovation, the business sector, new enterprises, and powerful partnerships, as well as a convincing management structure, which is absolutely vital for a project of this scale."

The project will facilitate the formation of a more comprehensive innovation and technology transfer ecosystem in the realm of research into modern materials and the use of such materials in innovative products, thus paving the way for the launch of new advanced technology and high added value manufacturing companies – an effort which epitomises the ends for which Teaming was established.

Robert-Jan Smits, Director-General of the Directorate-General for Research and Innovation at the CAMART² project kick-off meeting in Riga, Latvia, February 20, 2017

About ISSP UL

The Institute of Solid State Physics of University of Latvia (ISSP UL) is an internationally recognised leader with 40 years of experience in the material sciences and cross-disciplinary topics in Latvia, which provides internationally competitive research and innovative solutions for industrial applications. The institute currently employs more than 200 staff and provides modern infrastructure for different kinds of material analysis, including the scanning electron microscope, transmission electron microscope, atomic force microscope, X-ray fluorescence microanalysis apparatus, universal X-ray diffractometer and other analytical equipment which also serve the research needs of industrial partners. Most of the advanced tools are installed in the clean room facilities.

Along with developments in the scientific arena, ISSP UL has developed solid collaboration with high level innovation industries in Latvia. Technological and scientific research outcomes of ISSP are transferred into several spin-off companies.

Research and co-operation interests:

- Thin films and coating technologies;
- Functional materials for electronics and photonics;
- Nanotechnology, nanocomposites and ceramics;and
- Advanced structure analysis and computational material modelling.

ISSP UL on the road to excellence

Established for education and science and first developed as a strong player during Soviet times, the ISSP UL has become a significant regional centre of excellence for technology transfer in the Baltic Sea region.

The foundation of the ISSP UL was in 1978 when research on ionic crystals, glassy materials, ferroelectric materials and fundamental research of amorphous semiconductors, as well as development of measurement equipment for automatization of solid-state physics experiments were the main workstreams. By the late 1980s, the ISSP UL had become one of the biggest and most prolific physics centres in the field in Latvia and the former USSR.

The early 1990s was rough for research as orders from the space, military and nuclear industries of the USSR dropped, demanding changes in the market and in scientific focus during the transition from Soviet to Western preferences.

Several new groups were added from other institutes. Several important research and development milestones have been reached since the millennium, paving the way for the next milestones of ISSP UL on the road to excellence.

Milestone 1

In 2001, the centre of excellence at the ISSP UL was established by the realisation of the EC FP5 project CAMART ("Excellence Centre of Advanced Material Research and Technology at the Institute of Solid State Physics, University of Latvia"). The objectives were: research on functional materials and new technologies for microelectronics and photonics; high impact publications and international networking; attraction of young researchers; and the growth of industry collaborations. The scientists of ISSP UL actively participated in the research on fusion and in 2001 initiated the establishment of the Latvian EURATOM Association (AEUL).

Milestone 2

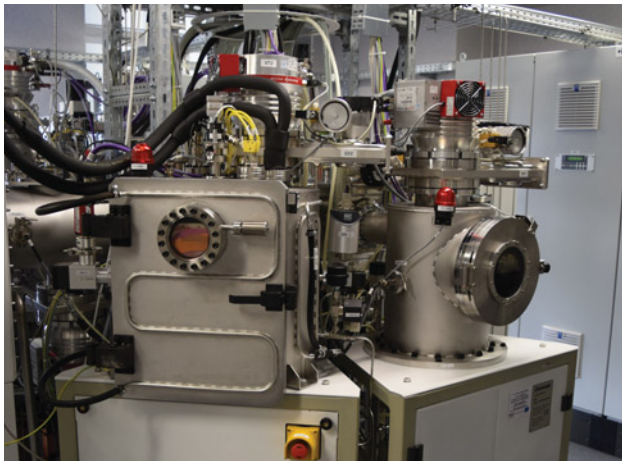
Since 2005 ISSP UL has been a co-ordinator of several National Research Programs in Materials Science and Information Technologies: “Development of advanced functional materials for microelectronics, nanoelectronics, photonics, biomedicine and constructional composites, as well as related technologies” (2005-2009); “Development of novel multifunctional materials, signal processing and information technologies for competitive knowledge-based products” (2010-2013); and “Multifunctional materials and composites, photonics and nanotechnology” (2014-2017).

Milestone 3

In 2006, a series of conferences on Functional Materials and Nanotechnologies (FM&NT) was initiated and organised by ISSP UL. Started as a local conference, it has expanded into an international event, attracting more than 250 participants annually from the countries of Baltic Sea region from all over Europe and the world. The diverse country list is an indication of the importance of the conference for scientists working in various fields. For seven years, FM&NT was organised by the Institute of Solid State Physics, University of Latvia. In 2013, the event moved to Estonia, and was organised by the Institute of Physics, University of Tartu, then returned to Riga in 2014 and in 2015 was organised by Vilnius University, Lithuania. Selected speakers and a good balance between the topics of the conference ensure its growing popularity. The next FM&NT conference in October 2018 will be organised by ISSP UL in Riga, and will be dedicated to the 100th Anniversary of the Baltic States and the special achievements in material science during the last period.

Milestone 4

In 2012, ISSP UL became a co-ordinator of ERDF project “National Research Centre of Nanostructured and Multifunctional Materials, Constructions and Technologies” – an infrastructure development project aimed at complementary build-up of advanced Latvian network of equipment and technological facilities. Latvian Nanostructured Material Research Centre (LATNANO-C) as a part of ISSP was established under this ERDF project and over €4m were invested in a clean room facility and the relevant equipment. LATNANO-C is used for research, education (master's, doctoral and post-doctoral studies), innovation (technology transfer in close co-operation with companies) and for international co-operation.



Milestone 5

In 2014, ISSP UL participated in the EC program Horizon 2020 within the framework of the Work Programme 2014-15: "Spreading Excellence and Widening Participation Call: Widespread 1-2014: Teaming" for funding to upgrade the existing at ISSP UL Centre of Excellence into CAMART² – Centre of Advanced Materials Research and Technology Transfer. In the competition of total 169 proposals, CAMART² project was the third best proposal of the first stage selected by EC for the preparation of the business plan to enable efficient transfer of new materials and technologies into products for commercial and public benefits.

Milestone 6 – CAMART² project – Implementation and impact

In 2016, the winners of “WIDESPREAD 1-2014: Teaming” competition second stage were announced. The ISSP UL project CAMART² – Centre of Advanced Materials Research and Technology Transfer was the only scientific institution in the Baltic Sea region, which was granted 15M EUR support from the European Commission.

CAMART² is based on the in-depth collaboration between ISSP UL – an expert in advanced sciences and currently the highest ranked research institute for the applied materials physics in Latvia, KTH Royal Institute of Technology (KTH) – the largest technical university in Sweden, and RISE - Research Institutes of Sweden. The Swedish partners are reputable in education, research, and innovation; they are leaders in Kista Science City of Stockholm – an innovative environment with a global reputation for encouraging strong co-operation between business, academia and the public sector in order to ensure continued growth, resulting in a continuously increasing number of start-ups and growing companies. ISSP UL, which is renowned for its scientific achievements, has the potential to improve as an entrepreneurial and innovation-driven organisation.

Together, the partners will strengthen ISSP UL so that it becomes the most important centre of excellence for education, research, innovation and technology transfer in the Baltic States. In effect, ISSP,

KTH and RISE will involve in the creation of a Riga-Stockholm Collaboration and Technology Transfer Platform (RIX-STO) for applied materials physics research and innovation related to high-tech developments and corresponding industries in the region. The platform will promote the development of new products and start-up enterprises through enhanced interactions between students, scientists and entrepreneurs.

The centre of excellence will establish open-access laboratories (OALs) to offer internal research groups as well as external academia and companies access to state-of-the-art scientific and technological facilities for materials synthesis, small-scale device manufacturing, and a versatile characterisation laboratory with some unique techniques and expertise. The OALs will be a part of the ISSP UL innovation system and will strengthen the entire Baltic Sea region with respect to research infrastructure access and on a European level provide access to a mixture of unique technologies and competences.

To support ISSP UL's research programme and upgrade centre of excellence at ISSP UL infrastructure development with increased Technology Transfer abilities is planned to accomplish in 2017 – 2021 with the budget more than €16m allocated for ISSP UL. All development actions including the second phase of LATNANO-C are intended to be realised in synergy with CAMART² project. Finally, ISSP UL facilities will become an OAL serving needs of public research institutions and high added value SME and industry in the Baltic Sea region.

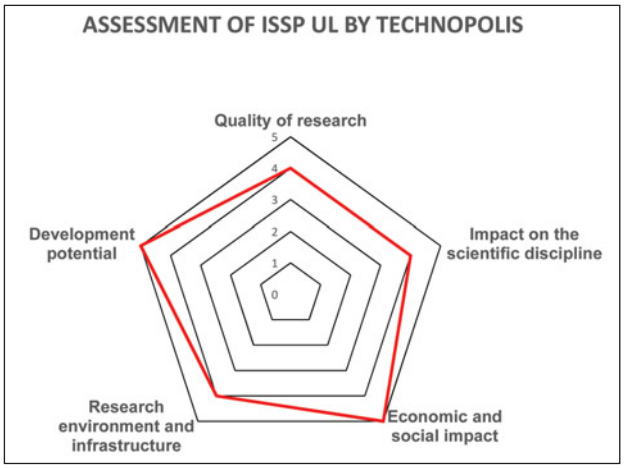
ISSP UL – CURRENT SITUATION AND RESEARCH PROGRAMME

Currently, ISSP UL has again become one of the largest institutes and a leader in the material sciences and cross-disciplinary topics in Latvia. The latest assessment of the research performance of Latvian scientific institutions was performed in 2013. According to the results, ISSP UL was ranked number one among institutions assessed by the Natural Sciences and Mathematics panel and as the second best institution of Latvia. 'The Institute of Solid State Physics, University of Latvia, is a leading research centre in Latvia that can provide internationally comparable research in materials science, educate students in modern technology and material studies, and provide innovative solutions for industrial applications. This institution is one of the best – arguably the best institution evaluated by the Panel. It has all the qualities to continue its role as the leading centre of Latvian research in material science.' (Technopolis group research assessment exercise, 2013).

At present, ISSP UL employs close to 100 PhDs (~3% of active scientists in Latvia), almost one third of them are early-stage researchers. Over the last decade it has produced more than 10% of Latvian scientific publications. Currently, ISSP UL personnel in total consists of 200 employees.

The present development strategy formulates the practical implementation of the mission of the ISSP UL in the years 2017-2022 following its general mission: to transfer excellence in materials science and solid-state physics into highly educated people and innovation.

Research, development and innovation activities are tactically assessed. Taking into account global trends and local needs, the H2020-funded project CAMART² goals are closely related to the Key Enabling Technologies (KETs) – Advanced Materials, Photonics, Nanotechnology and Micro- and Nanoelectronics identified in the European Union's scientific strategies – and fit into the Latvian RIS3 topic 'Smart materials, technology and engineering'. Targeted applications of advanced materials are planned: in energetics, particularly for energy harvesting, storage and economic exploitation; and in ICT, especially for information acquisition (sensors), processing, transmission and storage.



MAIN PRIORITY RESEARCH DIRECTIONS IN THE ISSP UL RESEARCH PROGRAM

Functional materials for electronics and photonics

In the spotlight of this research direction is the development of new materials valuable for light emitters, sensors and photonic applications in ICT and energy harvesting. A wide variety of material classes ranging from inorganic single crystals to amorphous polymers are within the scope of ISSP UL research. Special attention will be given to prototyping of photonic and microelectronic devices based on the developed materials in close cooperation with Latvian SMEs.

Nanotechnology, nanocomposites and ceramics

The research at ISSP UL will cover novel nanomaterials and nanostructures, nanoceramics and polymer nanocomposites, lead-free ferroelectric ceramic materials, materials for batteries, hydrogen production and storage, as well as for thermoelectric devices. These activities will, in particular, pursue investigations of different nanowire based applications, studies of glass ceramics for numerous photonic applications, development of lead-free multiferroic materials, new sodium ion batteries and new materials and innovative technologies for hydrogen energetics.

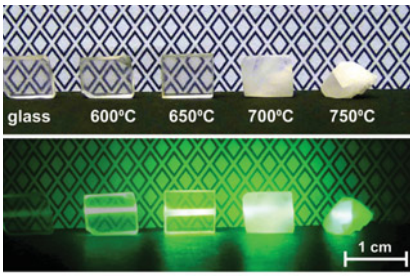
Thin films and coating technologies

The R&D activities will address so-called 'Green Thin Film Nanotechnologies', which are based on vacuum technologies as physical, PVD and pulsed laser deposition (PLD), as well as chemical vapour deposition (CVD) and organic and inorganic spray-wet technologies. Development of infrastructure, technological processes and a search for new applications in the field are also of high economical priority for Latvia, which has one of the largest vacuum technology industries among the Baltic countries.

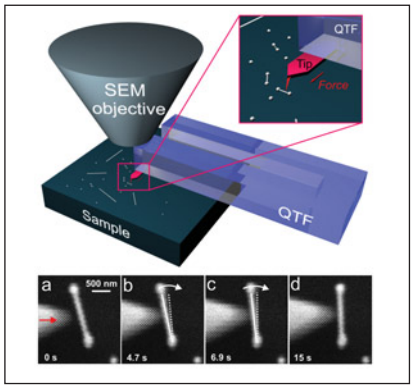
Theoretical and experimental studies of materials structure and properties

The development of existing and novel theoretical and experimental tools are of crucial importance for characterisation, testing and studying of (nano-) materials structural, electronic, magnetic and optical properties. These tools include high performance computing, X-ray absorption and optical spectroscopies, scanning/electron/optical microscopy and structural methods.

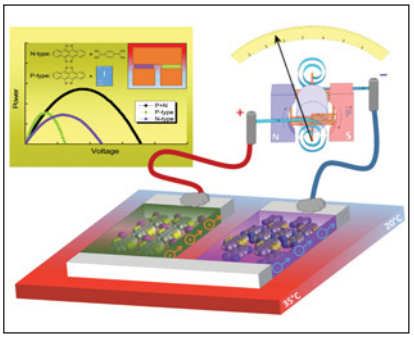
Upconversion luminescence in oxyfluoride glass and glass ceramics containing Ba4Gd3F17:Er3+ nanocrystals excited at 975 nm. For details see: G Krieke *et al.* Journal of the European Ceramic Society, 37 (4), pp. 1713-1722, (2017)



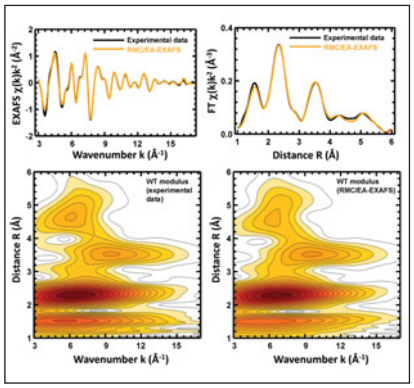
Schematics of inside SEM manipulation of metal nanodumbbells (NDs). The metal ND on the silicon wafer is pushed by an AFM tip glued to one prong of the QTF (force sensor). ND manipulation process is monitored in real time by SEM (a-d). For details see: B Polyakov et al. Phys. Scr. 90 (2015) 094007



Using vacuum technologies a "Proof of Concept" device of thin film organic thermoelectric generator elaborated at ISSP UL. For details see: K Pudzs *et al.* Advanced Electronic Materials, 2017, DOI: 10.1002/aelm.201600429



Top panels: comparison of the experimental and calculated Cu K-edge EXAFS spectra and their Fourier transforms (FT) for Cu3N. Bottom panels: wavelet transforms of the EXAFS spectra. For details see: J. Timoshenko *et al.* Phys. Scr. 91 (2016) 054003



Institute of Solid State Physics
University of Latvia
8 Kengaraga Str.,
Riga, LV-1063, Latvia

Phone: +371 67132778
E-Mail: issp@cfi.lu.lv
Web: www.cfi.lu.lv/eng

INSTITUTE OF SOLID STATE PHYSICS
UNIVERSITY OF LATVIA

CAMART²

H2020 project
funded by the
European Union