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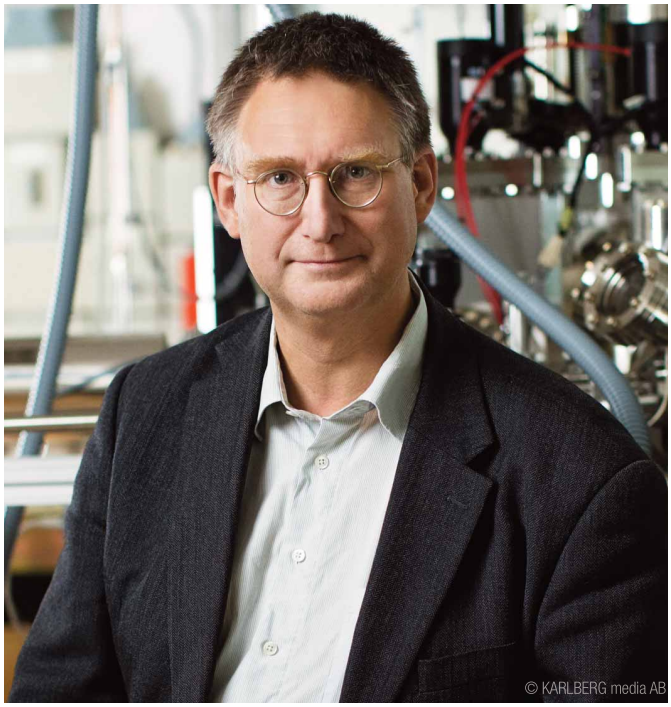
A Latvian-Swedish regional action boosts innovation and scientific excellence

Dr Līga Grīnberga, Head of the Information and Communication group at the University of Latvia's Institute of Solid State Physics, discusses the achievements of the Latvian-Swedish platform

CAMART² has provided the Institute of Solid State Physics at the University of Latvia (ISSP UL) with an opportunity to become a trans-Baltic hub for scientific excellence, boosting technology transfer and starting innovation in the region and beyond.[1] A long-term strategic relationship has also been established with Swedish partners – the Royal Institute of Technology (KTH) and Research Institutes of Sweden (RISE).

ISSP UL is one of the leading research institutions in Latvia, with a strong scientific foundation. It is also the place that the CAMART² project has raised research capabilities by implementing new research strategies and developing infrastructure to fortify the institute's priority research directions – which include materials science, nanotechnology, thin films, photonics, and micro and nanoelectronics. The project has also utilised a new approach to direct fundamental research towards technological needs and industrial challenges.

Dr Līga Grīnberga, Head of the Information and Communication Group



Nils Nordell, Director of the Electrum Laboratory of KTH

RISE is Sweden's independent, state-owned research institute and is the innovation partner in the CAMART² project. Through international collaboration programmes with industry, academia, and the public sector, RISE ensures the competitiveness of the Swedish business community on an international level and contributes to a sustainable society.

Since its foundation in 1827, KTH has grown to become one of Europe's pre-eminent technical and engineering universities, as well as a key centre of intellectual talent and innovation. KTH works closely with industry and society in general in the pursuit of sustainable solutions to some of humanity's greatest challenges: climate change, the future energy

supply, urbanisation, and the ageing population's quality of life.

Technology transfer

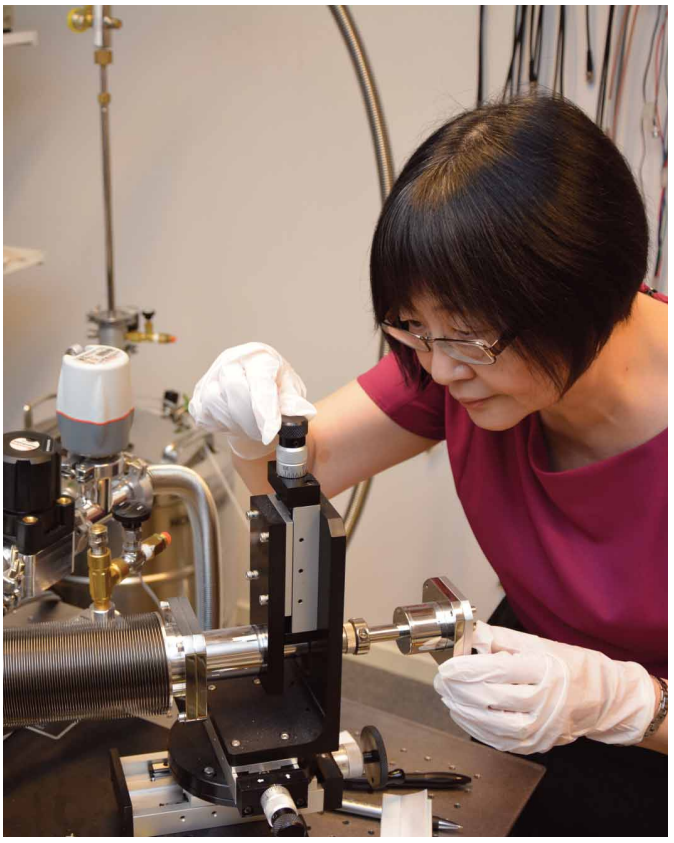
A significant element of the mutual regional partnership between ISSP UL, KTH, and RISE is the establishment of a collaboration and technology transfer platform for applied materials physics research and innovation. This aims at enabling high-tech developments within the region's industries, promoting new products and start-up enterprises, and strengthening collaboration through close interactions between students, scientists, and entrepreneurs.

This platform was originally called 'RIX-STO', as a foundation of the consortium consists of the CAMART^2 project partners – ISSP UL (Riga), KTH and RISE (both Stockholm). However, this network has since been enriched by Chalmers University of Technology and Linköping University, and various activities are being performed in an effort to expand co-operation with other relevant partner organisations across both countries. As such, a more suitable title was chosen – the Latvian-Swedish platform. This has already bore fruit in many ways – an active scientist-to-scientist collaboration, an exchange of ideas during hackathons, mutual research visits, workshops, and much more.

Ga_2O_3

According to Nils Nordell, Director of the Electrum Laboratory at KTH, research into a novel material gallium oxide (Ga_2O_3) stands out as an example of a fruitful research collaboration between KTH, RISE and ISSP UL. Common research is aimed at the improvement of the performance of Ga_2O_3 for future power electronics which will be included in electric vehicles and wind power plants. Ga_2O_3 is an example of a material that has quite suddenly emerged as candidate for many novel device applications. Although the majority of current research efforts are focused on improving material quality and developing process technology, the unique physical properties of Ga_2O_3 offer potential use in such divergent application areas as power devices for electric vehicles, thin film touch screens, and UV sensors. One urgent application could even be as a sterilising emitter of UV radiation in the battle against the SARS-CoV-2 virus which is causing the COVID-19 disease!

The benevolent features of Ga_2O_3 have been discussed within the Latvian-Swedish platform's collaborating groups which, a few years ago, pooled their resources to make best use of the advanced synthesis and material characterisation facilities at



Dr Qin Wang, Senior Expert at RISE

ISSP UL and the device design and fabrication capabilities at KTH and RISE. This ongoing collaboration has, so far, generated several applications for research grants and joint publications.

For example, a project prepared by Professor Juris Purans (Head of the Thin Films Laboratory at ISSP UL) is dealing with epitaxially grown Ga_2O_3 thin films as ultrawide bandgap topological transparent electrodes for ultraviolet optoelectronics. This project received the highest level of evaluation by the EU Project Review Panel, which stated: 'This proposal is of high scientific quality, timing and credibility'.

Meanwhile, valuable co-operation with Professor Anders Hallén's group at KTH has included sharing the experience and evaluation of results on Ga_2O_3-based devices, including providing assistance on design and characterisation.

Commercialisation

In addition to fundamental research, the Latvian-Swedish platform strives towards applications at higher technological readiness levels and the market introduction of new devices. RISE and the ISSP UL team for industrial collaboration, Materize, are highly involved in the ongoing Ga_2O_3 work and plans for if (and how) the new findings can be commercialised in the future. A very good example is a new joint application of Ga_2O_3 devices as UV-light emitting

Pēteris Lesničenoks, PhD student and researcher at ISSP UL

diodes (LEDs) for passivating the SARS-CoV-2 virus, which was recently submitted by Dr Qin Wang and her colleagues at RISE.

GQD sensors

Another remarkable project in which Wang, a senior expert at RISE, is included concerns the detection of amphetamine by using graphene quantum dots (GQDs). In recent years, RISE has established a collaboration with the Swedish National Forensic Centre (NFC)[2] which is aimed at the development of cost-effective onsite crime scene analysis tools for the detection of narcotics and the age determination of biological traces (such as blood, for example). Encouragingly, in the frame of the CAMART[2] project, scientists and students at ISSP UL have joined RISE's ongoing R&D activities in this area.

Wang explains that amphetamine-based illegal drugs constitute a large percentage of the illegal substances that are confiscated by police. GQDs have unique photophysical properties, which make them particularly attractive for multiple-substrate monitoring. Different types of un-doped and doped GQDs have been synthesised at RISE, KTH and ISSP UL, and have gone on to be applied and compared as amphetamine sensing elements. The experimental results have been reviewed by NFC. Moving forward, further investigation of how GQD properties change upon interaction with the compounds found in the amphetamine capsules/tablets and which could potentially be used to mix or 'cut' the narcotics – such as binding agents, caffeine, and sugar – will be continually pursued by the RISE/KTH/ISSP UL team.

The outcome of this work would provide insight on how GQDs can be applied as a core detection component within a portable forensic system. Such joint effort strengthens the scientific and innovation collaborations between RISE/ISSP UL/KTH/NFC under the Latvian-Swedish platform's collaboration umbrella. This would potentially enable helpful technical solutions to be provided to forensic labs/centres, as well as to related industrial partners in Sweden, Latvia, and other EU countries.

Photonic sensors

In addition, two doctoral and one undergraduate student from ISSP UL are involved in the synthesis of N-Carbon- or nitrogen-doped carbon nanomaterials for use in photonic sensors. Current research has shown that nanomaterials developed at the ISSP UL demonstrate a sensory effect against amine groups in KTH-formed sensors.

PhD student Pēteris Lesničenoks said: "We are very pleased to work with such professionals as Dr Wang from RISE and Professor Toprak and his team from KTH and it is great to take advantage of the opportunities offered by the Latvian-Swedish platform, which was established by CAMART[2]. It is inspiring to see that the material we have synthesised and studied as a result of its other properties for application in energy storage can be used in an absolutely different field – forensic science. This makes us widen our horizons and really see the synergies between different fields of physics."

References

1 The CAMART[2] project has received funding from the Horizon 2020 Framework Programme H2020-WIDESPREAD-01-2016-2017-TeamingPhase2 under grant agreement No. 739508

2 The RISE collaboration, along with the Swedish National Forensic Centre (NFC), is supported by the Swedish innovation fund agency, Vinnova, and the Swedish Foundation for Strategic Research

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