Swedish Graphene Forum

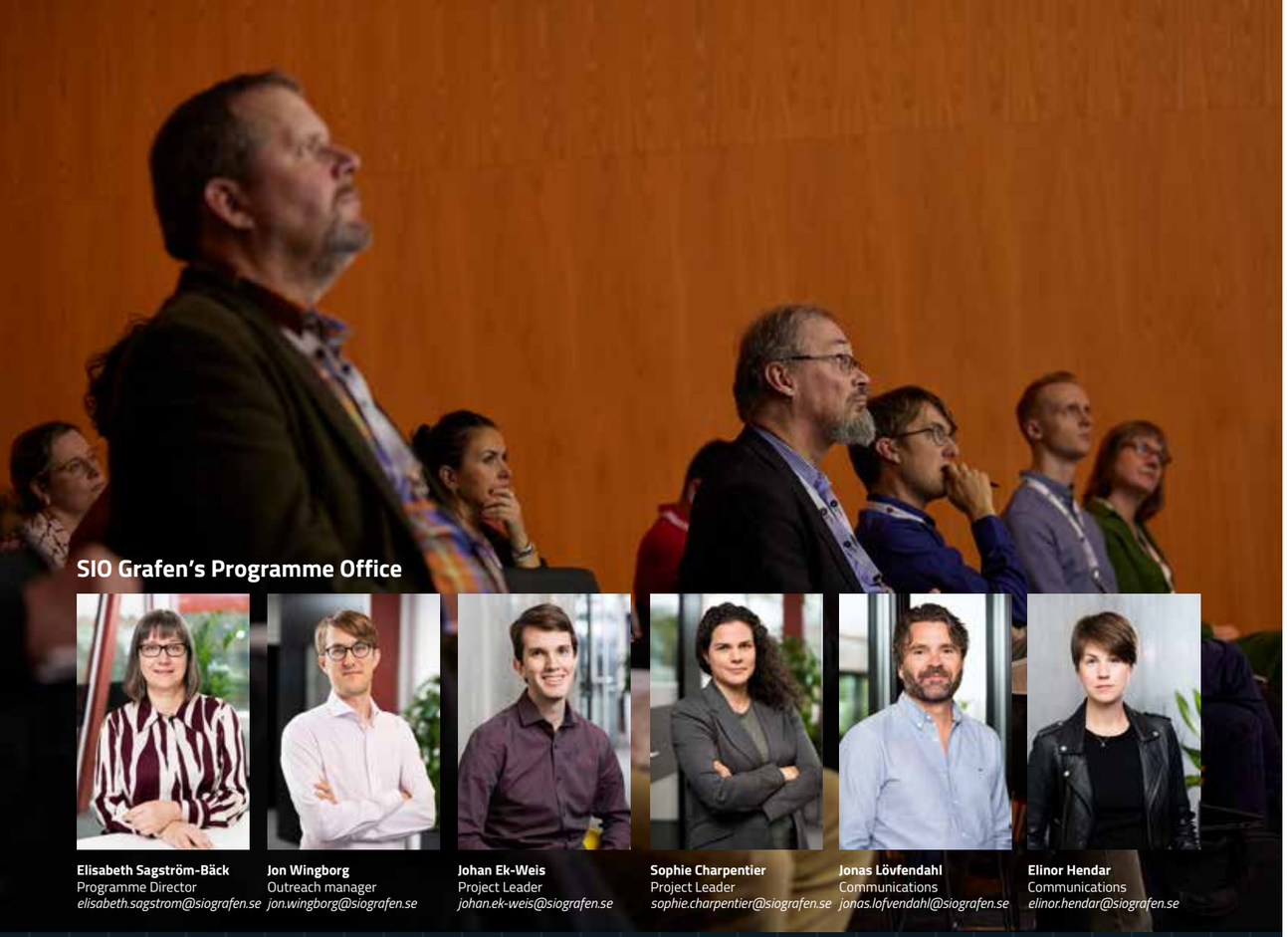
2022

The 2D experience

Around 100 people gathered over two days when SIO Grafen arranged Swedish Graphene Forum 2022 in Sundsvall. The crowd enjoyed over 30 presentations showing the advances made within the strategic programme, and the growing Swedish industry of graphene and other 2D materials.

– We shared project results in hot topics such as batteries, AI and medtech, but also in novel areas such as how to preserve art by using graphene. I am delighted to see hard evidence that our 2D industry is growing and pushing on towards industrialisation, says Elisabeth Sagström-Bäck, Programme Director of SIO Grafen.

SIO GRAFEN



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Front page: Britta Andres, project leader at 2D fab, during the study visit 19 October. Photo: Olle Melkerhed.

An innovative hot spot

Everyone who is anyone in the Swedish graphene and 2D-business was in the house. Well almost, anyway! We got fascinating updates regarding this increasingly important part of Swedish industry. In this magazine, it is your turn.

Swedish Graphene Forum is Sweden's largest conference for graphene and 2D materials. It is a SIO Grafen arena where industry and academia come together to share groundbreaking innovations and revolutionary results.

After some pandemic years of digital events, it was a pleasure meeting everyone in person in the beautiful city of Sundsvall.

100 people gathered over a couple of days and had a networking blast with 33 presentations and study visits at Mid Sweden University, 2D fab and Granode Materials. Together we hiked the innovation path from lab to industry and saw the Swedish 2D-industry picking up speed.

We saw representatives from large companies such as Volvo Trucks, Saab and ABB connect with research institute RISE and research foundation Chalmers Industriteknik.

We saw startups such as Adsorbi, Smena Catalysis and Tribonex making names for themselves and presenting an exciting future.

We saw Andrew Marais from Sweden's innovation agency Vinnova and Jari Kinaret, head of the EU research giant Graphene Flagship, taking big part of the conference.

We saw the winners of SIO Grafens Innovation Competition and Best Master Thesis Competition being presented and awarded, read about them on page 16.

We saw grand universities such as Chalmers, Linköping and Luleå connect with the industry.

You get the picture.

Now, let's work together for a sustainable and even brighter future.

Stay curious,

Programme Office SIO Grafen

SIO GRAFEN

Paint it black – make it last

Air pollutants destroy pieces of art all over the world. With the help of graphene, this growing problem could be about to get solved.

Air pollutants is a huge problem in art conservation. The quality of, for example, paintings degrade over time. In this project Adsorbi together with Chalmers have developed a pad which you keep close to the painting in order to adsorb the pollutants.

– Graphene is an important addition to the pads as the material increases the surface area and adsorption capacity and thereby gives longer life-time and requires less replacement work. Graphene also allows the pads to capture a wider range of pollutants and therefore gives a more secure protection, says Hanna Johansson from Adsorbi.

Museums and other art collectors crave a solution to this problem. Works of art emit pollutants which makes them degrade and age fast. An innovative adsorbent material with graphene could be the answer.

– Museums are happy to work with us in this project. They are very keen on testing new materials and new solutions to this problem and graphene could be an important key factor going forward, says Hanna Johansson.

Facts! Darker colour

Graphene adds multiple positive effects regarding art preservation. And besides capturing a wider range of pollutants and extending the lifetime of storage pads, it also changes the colour of the pads. With graphene, Adsorbis storage pads gets a darker colour that looks better and more discrete in exhibitions.

Project name: Graphiti - adsorbents with cellulose and graphene for art conservation

Graphene-nanodots for sustainable fabrication of light-emitting devices

Medtech is pushing to make light-treatments accessible. One application is the treatment of neonatal jaundice, which annually affects 84 million newborns worldwide and is cured by exposure to blue light.

Here, LunaLEC and Umeå university work on a biobased, sustainable and low-cost manufacturing method which could make cheap light-emitting blankets available to more people.

– We use graphene nanodots for sustainable LEC (light-emitting electrochemical cell) emitters. We kind of cook this biobased raw material down to graphene nanodots and make ink. Today we can produce two different colours and can move on with large scale coating, says Christian Larsen from LunaLEC.

Graphene switchable wave-guides for high frequency applications

In this demonstrator project Chalmers, Gapwaves, RISE and Saab used the tunable conductive properties of graphene to induce a switching effect in waveguides for high frequency applications. The switch design is based on gap-waveguide technology and covers the band 24-31 GHz frequenzy.

– A graphene patch was embedded into a gap-waveguide structure and we performed electro-magnetic simulations. The middle part of the waveguide has an electromagnetic bandgap structure to block the wave from being transmitted, thereby allowing the waveguide switch to have an ”off” state. A graphene sheet on top of this electromagnetic bandgap structure can make it work as “on” state. Now we will try to optimize the sheet resistivity of graphene sheet to switch between on and off state, says Sadia Farjana from Chalmers.

Graphene image analysis by machine learning

– A high-throughput, low-cost and general characterisation technique for quality control of graphene flakes is highly desirable. Image analysis from optical microscopy has the potential to be one of such methods, says project leader Lilei Ye from Chalmers Industriteknik.

Chalmers Industriteknik, 2D fab, Chalmers and Grafren are in this project developing a fast technique to characterize the number of layers in graphene flakes using optical microscopy. It is supposed to replace other low-throughput and expansive methods to provide a better solution for increasing volume production of graphene industry.

Graphene oxide coated fibres for improved chemical resistance of fibre reinforced plastic

Glass fibre reinforced plastics (FRP) are used extensively within the chemical industries. But it is very vulnerable to hydrofluoric (HF) acid, even at low concentrations.

The aim of this project is to improve the chemical resistance of commonly used fibres by modifying the surface with graphene oxide to form a protective layer, this to extend the service life of the FRP.

– We will expose these materials, then test them and see how resistant they are, says Stacy Trey from RISE.

The project is a collaboration between RISE, Grafren, Ineos Composites and Simona Group and keeps going into 2023.

Millimeter-wave graphene enabled wireless communication

Can graphene be used as a transmission line for better wireless communication? SafeRadar Research Sweden, Chalmers Industriteknik, Halmstad university and Raytelligence now evaluate graphene's potential to compete with commonly used conductive materials, such as copper or aluminum.

Graphene has metallic electrical characteristics, is frequency-independent up to a few THz, has high carrier mobility and lower skin depth effect.

– Graphene is an ideal candidate for this! Transferring CVD graphene on the glass will be transparent but expensive, while graphene ink and films from flakes are good for volume production but not transparent. Simulation and testing will be carried out to choose a suitable graphene for our application, says Lilei Ye from Chalmers Industriteknik.

Development of enhanced TIMs for electronics and power module cooling applications

SHT Smart High-Tech, Talga and Chalmers have tried both physical and chemical methods in this project regarding graphene flakes modification. The disadvantages with chemical methods were complex reactions, high cost for large scale applications and that graphene flakes easily get chemically connected. But with physically treated graphene flakes they saw good dispersion in water and no floating on the surface.

– Based on the film we will prepare a thermal interface material (TIM). Going forward we will optimize the film casting process and do thermal and mechanical characterization of the cast film. We will keep working on the manufacturing of the graphene enhanced thermal interface material, says Tongchang Zhou from SHT.

Multifunctional graphene-enhanced thermoplastics for aerospace applications

Saab, Chalmers, 2D fab, Linköping University and the Brazilian university UFABC collaborated in this project to develop new graphene-enhanced thermoplastic material and thermosets with respect to multifunctionality. The aim was to significantly improve strength and to induce electrical conductivity via the graphene enhancement of the polymer. They used graphene films for laminated, high conductivity structures and functionalized graphene for optimized dispersion. They also did modeling and ran simulations.

– We got some good results with very high conductivity, also in nanocomposites for 3D-printing applications. Further tests on heat-exchangers are coming, says Sven Forsberg from 2D fab.

Silicon-graphene electrode composite for lithium-ion batteries

The estimated demand for energy storage 2030 is huge and transportation is the main cause. In 2019 there were 7.2 million electric vehicles worldwide, in 2030 the estimation is 240 million EVs. That means a lot of EV batteries.

Here, Mid Sweden University, VestaSI/SKF, 2D fab and Uppsala University investigates using a scalable furnace-technique to create silicon nano-particles on graphene in lithium-ion batteries to replace graphite.

- We need to improve the battery capacity and usage. We do this by adding silicon in the anode and see some good performance so far and are currently doing up-scaling tests of the technology, says Rohan Patil from Mid Sweden University.

Textile under pressure

For products aimed to be in close body contact, the contact pressure level is of big importance. Both from a comfort and from a health perspective. So, let's create new textile pressure sensors with added graphene – and have a seat!

This project aims to verify the performances of graphene-based, textile pressure sensors in selected products including hospital mattresses, wheelchair cushions, and various furnitures and related accessories.

– These sensors will be very useful to detect conditions which may lead to pressure induced injuries, due to too high pressure levels, or lower pressure levels acting over long periods of time. It is a big problem in hospitals today. We are also curious about how to best integrate and use them in future homes and smart furniture, says Valter Dejke, researcher from RISE.

The pressure sensors are based on graphene coated textiles, where adding graphene makes it a pressure sensitive fabric.

– Graphene based sensors offers several potential advantages compared to alternative sensor materials including large design flexibility, cost efficiency and being environmentally friendly. One big advantage is that, in the right application, no extra material components or layers are needed, except for electrodes and leads, since the original textile material is turned into to a sensing material using graphene coating, says Valter Dejke.

What kind of challenges do you see?

– Same as for all pressure sensors. It is about making them really accurate and reliable, you want a perfect relationship between pressure and resistance.

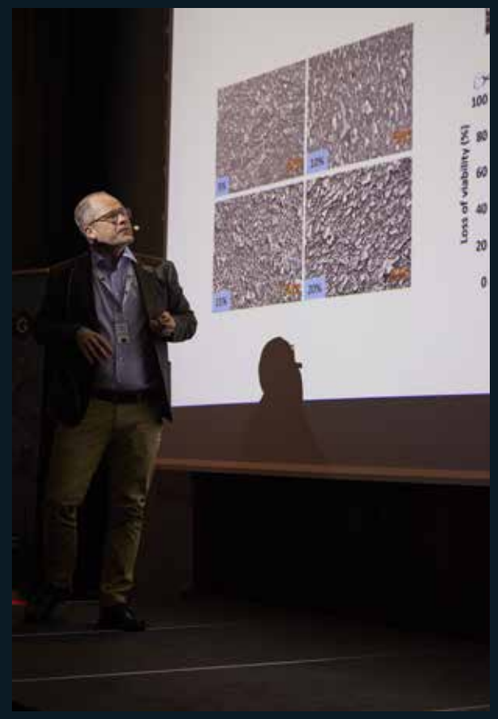
The project is ongoing, what is your conclusions so far?

– We can detect if it's pressure or not on the surface, and we can indicate movement. This is very important information for various healthcare related products. We are currently looking into the performance in more high-accuracy demanding applications. Altogether it looks good, we are quite happy with the results so far, says Valter Dejke.

Facts!

Project name: Verification of long-term properties of graphene-based textile pressure sensors.
Project partners: RISE and various companies including Grafren, ETAC, Järven Health Care and NEP.

“We are on our way”



Graphene-based antibacterial surfaces for medical devices

Wellspect has worked with graphene since 2015. In this project, together with Chalmers and 2D fab, they continue to explore vertical graphene flakes for antibacterial surfaces to reduce infections from medical devices and to optimise the surface in polymer substrates.

– We see a really strong effect! An indisputable progress with very high antibacterial effect, a fairly cheap solution, also with a mechanical killing effect which simplifies product registration. It is still challenging to find a stable process to make the most suitable surface, but we are getting closer and closer, says Martin Lovmar from Wellspect.

A low-cost dioxin sensor based on epitaxial graphene

Dioxins in the environment is a huge problem. And in detection, many sensors require the samples to be sent away to a specialized lab which can take several days to show results. In this project, Linköping university together with Envic-Sense are developing sensors that are both very sensitive, easy to use and fast. These sensors give a result already after 42 minutes!

– When thinking about sensors with low detection limits, think of 2D materials, says Jens Eriksson, project leader from Linköping university.

Bio-based graphene coatings for anode materials in Li-ion battery

This project by RISE and Granode Materials AB has the industrial vision to develop a green and high-performing anode composite technology and enter the estimated market value of $92 billion of which 7%-12% is derived for lithium-ion-battery anode manufacturing products until 2025. Where, the lithium-ion battery binder market aimed to approach $3.58 billion by 2030, according to the reports.

– Implementation of bio-based binders in next-generation anodes, i.e. offering a stable specific capacity of about 1000 mA h/g via addition of nanosilicon, is an emerging and important task in the battery field. In this project we would like to add a graphene coating together with bio-based binders in the anode slurry formulation to improve anode mechanical integrity and efficiency. We have already prepared first batches of graphite with starch-graphene and nanocellulose-graphene formulations and they demonstrate good homogeneity and viscosity properties suitable for anode preparation; says scientist Illia Dobryden from RISE.

Six projects dealing with challenges

There are several challenges shared by the whole community working with 2D material innovations. These topics are often too broad or large for individual companies to tackle or even to completely focus on. On the other hand, new insights and results could potentially benefit the entire community. At Swedish Graphene Forum in Sundsvall, six projects addressing this type of questions were presented. Their common goal is to reduce shared obstacles for improved innovation.

The importance of testbeds

There are a large number of testbeds available in Sweden. These offer the opportunity to evaluate new innovations, including with 2D materials. Many of these have experience with 2D materials whereas many don't require any additional setup in order to work with 2D materials.

– The opportunities with testbeds are rather unknown within our community, but these can potentially significantly speed up the breakthrough into the market. We have made a list available on the SIO Grafen homepage where it's possible to find over 40 testbeds relevant for development of innovations with 2D materials in Sweden, says Stacy Trey from RISE.

Linköping university, MEVA Energi, Megger Sweden and Nordic Electronic Partners also participate in the project.

Roll-to-roll graphene coating

One potentially very useful testbed would be to coat graphene composites in a conventional roll-to-roll process. Mid Sweden University are working together with Mondi and UMV to adapt an existing pilot plant into a testbed ready for graphene innovation.

– We believe this could open the door to many exciting graphene innovations. We can coat 60 cm wide paper at speeds of 300 meters per minute, which gives a feeling for the scale we are working at, says Nicklas Blomquist, project manager at Mid Sweden University.

Standardisation is the way forward

There are many different materials that commonly are referred to as graphene. These need to be characterised in a standardised way for manufacturers to be able to select the correct material with desired properties and to ensure reproducibility.

Standardisation is therefore very important in order to introduce a new material to the market and to facilitate industrialisation. Many of the Swedish suppliers of graphene as Bright Day Graphene, Grafren, Graphensic, Graphmatech and also LayerOne from Norway are working together with RISE, Chalmers Industriteknik and Svenska institutet för standarder - SIS in the project.

– We are working internationally in order to create new ISO-standards for graphene. One of our focuses is to create standards that work at a large scale and thereby are useful in industry, says Åsalie Hartmanis, project leader at Chalmers Industriteknik.

2D Graduate network

A lot of very competent people work with 2D materials in Sweden today. Swedish Graphene Forum gathers many of these and fosters new insights and collaborations. However, the same natural meeting point for young researchers has not existed until now.

– There are many very good young researchers in Sweden, but they can have difficulties connecting with industry. The idea of the 2D Graduate Network is to create a forum where they can meet and discuss. This creates important possibilities for young researchers and becomes an avenue to connect with our Swedish 2D industry, says network leader Jens Eriksson, Linköping university.

Working safely with graphene

There are health risks associated with manufacturing many materials and products that we use every day in our daily life. However, this is not a problem as long as it is possible to assess and mitigate the risks. There are generic methods for risk assessment of nanomaterials available, but nothing focused on graphene.

– The aim of the project is to develop methods to measure the exposure, quantitatively and qualitatively, to graphene in air and on surfaces and to evaluate when and how existing modeling tools can be used, says Håkan Tinnerberg project leader at Sahlgrenska university hospital who is working together with 2D fab, Chalmers, Chalmers Industriteknik and Lunds university in the project.

Worn out EV batteries as alternative carbon source

Graphite is the main precursor for making graphene. While graphite deposits are not scarce, the supply of high-quality graphite is much tighter and the demand is expected to significantly increase as it, for example, is used as a raw material for electric vehicle battery manufacturing. Chalmers University of Technology, Chalmers Industriteknik and Grafren have investigated the possibility of producing graphene without using pristine fossil-based graphite.

– We have focused on the possibility of using end-of-life batteries from electric vehicles as an alternative carbon source for graphene production. The market wants circularity and this can be an important step for future sustainable graphene production, says project leader Sofia Öiseth,Chalmers Industriteknik.

Behind the scenes

Pump DOWN the volume

Graphene as noise control material? Volvo Technology, Chalmers and SHT see promising results in a project aiming to get the volume down.

The most common method to control noise today is the use of porous materials, such as fiber or other foam-based materials. That's fine, but with a downside: they can be heavy! It would therefore be great to make them thinner but without reducing the noise-performance. However, thin materials are generally not good at reducing low frequency noise, but graphene could be the answer

– A lot of noise in vehicles used to be hidden behind the engine noise, but now with electrical vehicles noise reduction is even more important than ever before. The introduction of graphene in these materials show promising results to deliver light-weight and high-performance materials, says Flavio Presezniak, noise engineer from Volvo Technology.

The aim of the project is to evaluate the influence of graphene applications on acoustic materials, by conducting tests of graphene-enhanced materials.

– We expect that the introduction of graphene will increase the absorption properties. Reduced vibrations and lower frequency noise with thinner graphene enhanced materials. Then, theoretical models need to be elaborated to better understand the effect on the materials. I am really looking forward to the upcoming noise tests, says Flavio Presezniak.

Project name: Application of graphene-enhanced foam materials for noise damping in vehicles.

Grafcoat: Graphene-based extrusion coating for paperboard

RISE, 2D fab, and Holmen Iggesund Paperboard collaborate in this project where graphene is mixed with thermoplastic starch to obtain biopolymer -graphene composites with improved barrier properties. The long-term goal is to develop a biobased barrier material with low environmental impact, suitable for extrusion coating of paperboard for food packaging.

– The graphene addition gave interesting results, although there is optimization work to be done. Large-scale production is planned in a continuation project, says Wei Zhao from RISE.

Graphene enhanced conductive cementitious coating

Steel reinforced concrete is an important construction material often exposed in harsh environments, which leads to corrosion damages. Impressed Current Cathodic Protection (ICCP) is a well-known repair method. However, this method has its own challenges. These are often related to the anode.

– We try to overcome these challenges by using graphene, where one aspect is to improve the conductivity of coating as an anode. Our next step is to characterise the defects in the material after its service life and continue the demonstration scale of the project, says Luping Tang from Chalmers who is working together with Chalmers Industriteknik, GVV, Lanark, SIKA and Talga in the project.

Graphene based electromagnetic compatibility material

It is important to protect the electronics in many devices from electromagnetic radiation. However, conventional electromagnetic shielding materials are not recyclabe or renewable. The aim of this project is to produce new recyclable and lighter material for electromagnetic shielding based on graphene.

– We selected graphene coated wood fibre into a polymer matrix. With a new material its lots of things to learn from lab scale to production. We came up with a new EMI shielding test method of the material. Now we try 3D printing and its under development, we want to keep pushing this technology, says Hans Grönqvist from RISE.

Project members: RISE, Atlas Copco, Biofibertech, EMC Services, Graphmatech, Megger, Meva Energi.

CorroNite – a new thermochemical treatment for increased resistance against corrosion and wear

Project members Tribonex, Bodycote and Volvo CE have developed a sustainable and cost-effective treatment method to generate corrosion-resistant and hard-wearing surfaces, by combining heat treatment and surface coating.

– We see very positive results with improved corrosion resistance compared to the competing method of hard chrome, with equivalent performance regarding friction and wear. Another important aspect is that the manufacturing of CorroNite does not have the same environmental and health issues as hard chrome. We now move towards industrialisation and our aim is to have a launchable solution in place during 2024, says Linus Everlid from Tribonex.

Winners of the Innovation Competition

Smena Catalysis and Tenutec won SIO Grafen's Innovation Competition 2022. The 2D startups share a prize sum of SEK 600,000.

Around 100 participants at Sweden's largest conference for graphene and other 2D materials applauded the winners Smena Catalysis and Tenutec.

– We have seen six finalists of very high quality with ground-breaking innovations. The winners point out an exciting future in new materials. We will for sure hear a lot about them in upcoming years, says competition leader Jon Wingborg from SIO Grafen.

Catalytic properties

Smena develops a patented process to activate a very common and natural 2D material. The idea involves exploring the use of this material's catalytic properties to make the production of green hydrogen cheaper and less dependent on extremely rare materials.

– We are incredibly happy to win this. It means that we can immediately kick-start by hiring an expert in the field and thereby move forward much faster and evaluate this together with industrial partners, says Patrik Bjöörn from Smena Catalysis.

Upgraded cooling system

Tenutec develops graphene to increase the conductivity of the Thermal Interface Material (TIM) and a graphene-film that can replace today's cooling plates. The result is an upgraded cooling system with a conductivity that extends the life of electronics and makes them faster. This is made possible by the company's new, patentable production method where Tenutec can produce high-quality graphene without harming the environment.

– It is fantastic to meet Graphene-Sweden and be recognized in SIO Grafen's innovation competition. The prize makes a huge difference to us who are just starting out, we are very grateful. Stay tuned, because now things will happen, says Sebastian Ringqvist from Tenutec.

Master thesis of the year

SIO Grafen's prize for best master thesis on 2D materials with industrial relevance in 2022 was awarded to Awse Salha from Chalmers. Congratulations!

The winner was made public during Swedish Graphene Forum.

– I would like to thank my supervisors Samuel Lara-Avila and Naveen Shetty, as well as our research group at the Quantum Device Physics Lab, for their support and mentorship throughout my thesis research, said Awse Salha and continued:

– Moreover, I would like to thank my family and friends for supporting me in my education. Last but not least, I would like to thank SIO Grafen and the selection panel for honoring me with this award.

Awse Salha later picked up the award and prize sum of SEK 10,000 at the 2D Graduate Network's workshop in Linköping on 28 October.

Thesis title: Hydrogen Intercalation of Graphene: Towards Scalable and Uniform AB-Stacked Bilayer Graphene.

The jury's recognition: For a well-structured, well performed and well written master thesis with high industrial relevance, paving the way for future industrial use of epitaxial graphene.

We know graphene

We at the Programme Office are always willing to guide you through graphene and two-dimensional challenges. Don't hesitate to contact us for your next project. We are happy to share our expertise and advice.

Get in touch with us!

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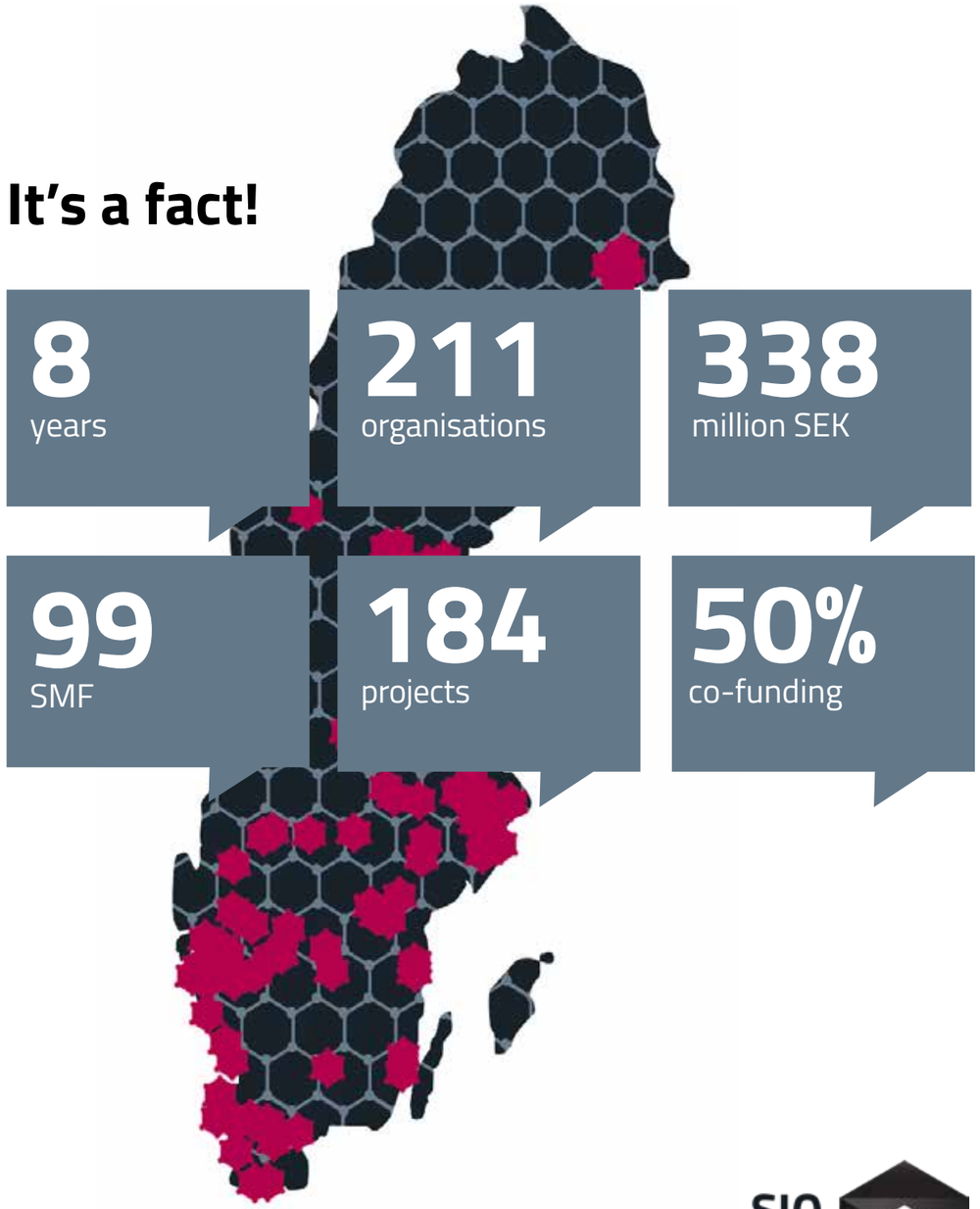
We bring graphene and other 2D materials from lab to industry.

It's a fact!



8 years

211 organisations

338 million SEK

99 SMF

184 projects

50% co-funding

SIO GRAFEN

Let's cool things down

A graphene thermal strap shows great promise in getting rid of heat created in airplanes. That is very cool news.

Chalmers, SHT and Saab AB collaborate to find a way to get rid of heat in airplanes by using graphene in a brand-new thermal strap.

Today's thermal straps on the market are not great regarding thermal conductivity. Furthermore, they are heavy, sensitive to vibrations and provide less flexibility.

The thermal strap in vibrational environment needs to have high thermal conductivity, low weight and be carefree, long-lived and flexible.

– Chalmers and SHT have done a lot of work regarding the graphene film and heat treatment. We have made a demonstrator and tried the thermal properties, and it looks promising that graphene thermal straps could contribute to handle thermal management in future designs, says project leader Ros-Marie Lundh from Saab.

They have seen the effect of heat treatment temperature at 1500, 2200, 2400, 2700 and 3000°C on the properties of graphene assembled films. They also did a thermal analysis of the graphene strap for two different widths in the demonstrator.

– The graphene straps work very efficiently, and the wide graphene strap shows the absolute best results. We also see that heat pipes are less efficient compared to graphene straps. We notice good fatigue and durability measurements, it looks to hold up over time, says Ros-Marie Lundh.

What's the main challenge in this project?

– When you take a fantastic innovation and test it thoroughly it is always challenging. I'm very hopeful that we will work it out and get these thermal straps out on the market, says Ros-Marie Lundh.

Facts! Why thermal straps?

Flexible, lightweight connection path for moving heat to a cooling structure, enabling point-to-point heat transfer.

Project name: Graphene thermal strap for electronic component cooling application.

Searching for the recipe

Graphene in metal 3D printing is working. Desired microstructure, increased hardness, decreased wear rate and a surprise anti-corrosion mode.

– This is very good news, says Marta-Lena Antti, professor in Engineering Materials at Luleå University of Technology.

The potential of combining Additive Manufacturing (AM) with graphene opens a great number of applications where high performance is demanded, such as the aerospace industry, orthopedic manufacturing as well as tooling and energy sectors. The technology is heading towards commercialisation.

Here, the project partners investigate the benefits of using graphene as a reinforcement material for powder bed fusion metal AM.

– By adding graphene many interesting questions and answers arise. The metal powder was coated before printing and work really well as we test printed cubes with different amounts of graphene. We found some great results, says Marta-Lena Antti.

They achieved high density, increased hardness and a desired microstructure with no segregation of phases – leading to good properties. The grain size within the metal decreased with the addition of graphene.

– Decreased grain size is a good thing! We also saw that critical pitting voltage increased with graphene and a distinctively decreased wear rate, says Marta-Lena Antti and continuous:

– What surprised me the most was the corrosion test, the cubes showed no signs of corrosion which is very interesting. We will do more tests on this in Uppsala.

Facts!

Project name: Framgraf II: Improved properties of additively manufactured metals by adding graphene.

Project partners: Carpenter Additive, Graphmatech, Amexci, GE Additive, Mid Sweden University, Uppsala University, Luleå University of Technology.

Next step: Demonstrator printing for end-user Amexci. Plus more corrosion tests, in combination with X-ray photoelectron spectroscopy.

Proof-of-concept of a novel gas sensor based on MoS_2 with hexagonal holes

Smena, a start-up from Chalmers, has developed a process where they activate a natural and abundant 2D material that can be used in gas sensing. With the source molybdenum disulfide ($MoS_{2)}$ they have made the edge-enriched Molybdenyx that changes its electrical properties upon exposure to certain gases.

– Although there constantly is a demand for even better sensors, there has been very little innovation in the gas sensing market for many years. Smena's technology works and is very promising, says Patrik Bjöörn from Smena.

High impact-resistant composites

The area of sport protection equipment is very sensitive to the weight and mechanical performance of the materials used. Even minimal improvement may be crucial not only for better sport achievement, but critical for safety or even survival of the athletes.

Here RISE, Grafren, Linköpings university and POC Sports wants to make lighter and stronger winter sport helmets with graphene modified glass fibres.

- It's a small addition of a few grams of graphene per square meter. We see a great potential not only here but also in the space and car industries. The next step is to test this in a drop rig in Linköping, says Mats Bergwall from RISE.

Graphene-cellulose composite for electrode applications

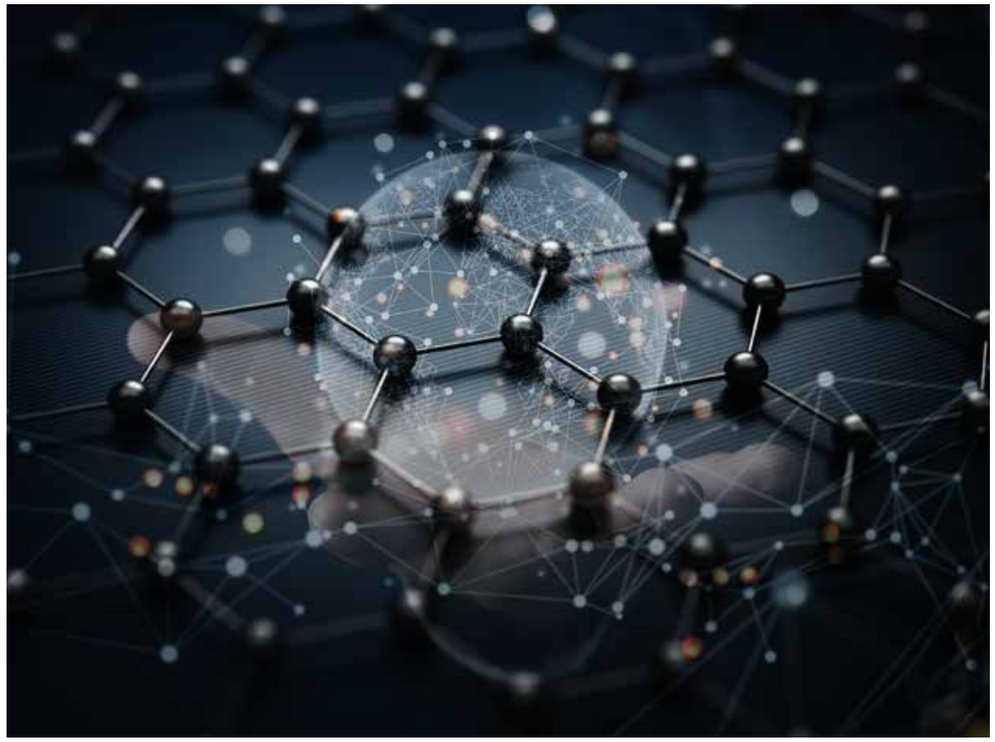
Project members Mid Sweden University, Holmen Iggesund Paperboard and RISE wants to find better versions than today's cellulose component in graphene-composite electrodes. A problem is that highly charged cellulose fibrils hold water and dewater slowly, with high cost related to drying. Now, the results with a new cellulose binder are positive.

– Our initial test was very good. Mechanically stable and fast dewatering. We will continue at Iggesund with large scale trials, and I think this will emerge to something great soon, says Magnus Hummelgård from Mid Sweden University.

Graphene for corrosion protection of pre-coated steel

Most steels require a coating for protection in harsh environments. RISE, SSAB, and NUC have studied graphene as a barrier additive to enhance the corrosion resistance of the SSAB-patented Green-Coat BT coil-coated steel. The next step is to incorporate optimized graphene dispersions in coating formulation and perform further testing.

– We have worked with the top coating and seen promising results. The level of dispersion is key, and we test which type of graphene works best. We strive for stability of the dispersion and perform different mechanical tests on the coating and field tests where we place it outdoors in a relevant environment. The graphene will add mechanical strength while acting as a barrier, says Wei Zhao from RISE.



Top ten in the world

SIO Grafen began as an initiative to kick-start the graphene development in Sweden and enable material advancement within the industry. Today we are a national Strategic Innovation Programme with the ambition to strengthen collaboration between industry and research providers in all 2D materials application areas.

Since 2014, we have had the opportunity to build an ecosystem for graphene and other 2D materials with the best material researchers, companies and entrepreneurs in the country.

By identifying and bringing together key players in value chains towards applications, we help turn the research of today into seamless solutions of tomorrow.

In our vision, Sweden is one of the world's ten leading countries in developing and using graphene and other 2D materials industrially.

SIO Grafen long-term goals

- Establishing 2D materials as a Swedish industrial area of strength.
- Creating a strong 2D material eco-system.
- Supporting complete value chains for graphene and other 2D materials.
- Ensuring that 2D materials are key factors in the transition to a sustainable society.

Membership – join us today

Get to the next level by becoming a SIO Grafen member. It is free of charge and lets your organisation be part of Sweden's best network regarding graphene and other 2D materials. Want to know more about the membership?
Email us: *info@siografen.se.*

SIO GRAFEN

”Moving towards a better future, together.”

Nice people

New contacts

Inspiring

Networking

New insights

Fun

Sustainable

Productive

Broad applications

Interesting

Wide tech use

Knowledge

Impressive

Friendly atmosphere

Innovation

Educational

Well organized

Great meetingplace

Informative

Collaboration

How would you describe Swedish Graphene Forum 2022?

We asked the attendees of this year's conference. These are some of their answers.

Source: SGF Menti Survey 2022

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