



 SIO GRAFEN

Svenskt Grafenforum 2017

- A short summary

Sophie Charpentier and Johan Ek Weis

20171020

Med stöd från:



FORMAS



STRATEGISKA
INNOVATIONS-
PROGRAM

Approximately 60 enthusiastic people gathered in Norrköping on October 17-19 for the third Svenskt Grafenforum, which is the yearly result workshop of SIO Grafen.

Helena Theander, the director of SIO Grafen, started the workshop with saying that the level of graphene innovation within SIO Grafen is improving. We are climbing on the TRL scale. Helena stressed the importance of collaborations and supply chains. She also asked for input concerning in which countries your preferred collaborating partners resides – in order for us to have the right focus.

Gemma Vall-Llosera from Ericsson Research quoted Mildred Dresselhaus (often called the "queen of carbon") saying that "Carbon may be to the 21st century what silicon was to the 20th". Gemma showed that Ericsson's main interest in graphene is in photonics and optoelectronics, what they have achieved so far and what the requirements on graphene photonics are.

Johan Ek Weis from Chalmers Industriteknik presented the collaboration with **SaltX Technology** for [utilizing graphene in heat pumps](#). Graphene is used to improve the efficiency by enhancing the thermal conductivity while keeping a low thermal mass, high inertness and high temperature resistance.

Thomas Gillgren from BillerudKorsnäs showed how they are [coating paper board in order to create an impermeable film](#). The technique currently leaves cracks in the coating, but the results are promising and they are planning on continuing working with graphene.

Lena Killander from Applied Nano Surfaces presented their use of [graphene in solid lubricants](#). They still have time left in the project, but could already show significant improvement of the wear rate, using graphene and especially graphene oxide as compared to SiC and TiO₂. Lena showed a spray bottle with graphene soon ready for market introduction.

Lilei Ye from Smart High-Tech AB (SHT) explained how graphene can be used in [coatings for marine applications](#). The addition of graphene forms an anticorrosion layer as the impermeable 2D structure creates a longer migration path. The hydrophilicity of graphene oxide and the improved roughness of the surface enhances the anti-fouling properties.

Arne Quellmalz from KTH presented their collaboration with **Senseair** for [making optical gas sensors with graphene on a wafer scale](#). They use graphene to be able to miniaturise the device, but still be compatible with silicon photonics, and to work in the desired wavelength range (mid-IR) and at room temperature.

Roro Yakoub from Saintpro showed how they intend to [save lives by utilizing graphene](#). They make composites with graphene in PC in order to reduce the weight of ballistic armour. They have promising results and are planning to optimise the results in a continuation of the project.

Carl Strandqvist from Nationellt Forensiskt Centrum, presented their collaboration with **Graphensic** for [using graphene based sensors for drug detection](#). They are developing several potential concepts to detect amphetamine and cocaine in a small, fast and very sensitive sensor. The next step is to increase the specificity of the detection, make a wafer scale study and work to minimize contamination of the sensor.

Sotirios Grammatikos from Chalmers showed how [graphene enhanced concrete can be used to facilitate monitor concrete structures](#), a project in collaboration with **Thomas Concrete Group**. The conducting graphene/concrete mixture is used as an additional layer around the measurement steel rods. This allows the structural monitoring to depend on the conducting concrete/concrete interface, which is much more stable than the steel/concrete used currently. In the next step of the project, they want to scale up and assess the durability on longer period of time.

Lilei Ye from Smart High-Tech (SHT) presented the collaboration with **Centrumpile** where they use [graphene in concrete to increase its compressive strength](#). Their results show graphene disperses well in the concrete, making it more durable and decreasing the time between pouring and demolding of the concrete structure.

Niklas Lorén from RISE Agrifood and Bioscience presented a project involving 9 actors, including **Stora Enso**, where [graphene is used as a packaging barrier](#). The aim of the project is to replace the aluminium layer used as an oxygen barrier in conventional packaging with a graphene/polymer composite layer. Their results are promising and in the next step they want

to have a better control on the orientation of the graphene platelets and aggregation as well as decrease the graphene concentration in the composite.

Olga Santos from Alfa Laval and Karin Persson from RISE presented their collaboration to use [graphene in corrosion protection and antifouling coating in heat exchangers](#). The objective is to decrease the maintenance needed of the heat exchanger, which is very costly.

Johan Ek Weis from Chalmers Industriteknik presented the new Innovation Agenda of SIO Grafen. To update the agenda, an assessment of where we are today was made, and from the vision of where we want to be in 2030, intermediary targets and goals have been set to ensure that this vision will become a reality. Johan presented the challenges, the target areas and the activities. He also mentioned that there are still 6 areas of focus, where the current two areas on electronics will merge and that composites will now be a separate area.

Helena Theander, the director of SIO Grafen, discussed LIGHTest, a testbed which includes several Strategic Innovation Programmes, SIPs. The aim is to study testbed pilots and develop generic best practise on management and way of working. Helena mentioned that it is important that SIO Grafen is involved already at this stage, even if the testing on graphene structures will take place in the future, to be able to provide feedback and make sure that new testbeds will be designed to handle 2D materials.

Mark Thompson from Talga Resources presented the graphene production and applications of Talga. Talga Resources owns a graphite mine in Vittangi, where the graphite can be used directly for exfoliating (no milling, no grinding is necessary). Mark also elaborated on the possibilities of collaboration with Swedish industry.

Mats Sandberg from RISE Acreo talked about their project where [graphene is used in printed electronics](#). Mats presented results from a study where printed conducting graphene electrodes were used to replace heavy elements in a radiation sensor array. He also discussed the possibility of using graphene in an anisotropically conducting adhesive to enable contact between slightly spaced electrodes.

Workshops

One workshop was dedicated to “Entrepreneurship in graphene” and the last one discussed the opportunities with the [characterisation checks](#).

Three workshops were dedicated to discussing common needs and challenges in the areas of coatings, electronics and energy.

For coatings there are several applications areas, different graphene materials, different methods and different substrates of interest, making it difficult to find generic project topics that fits all. Oxygen barriers, corrosion resistance, wear resistance, antifouling, electric conductive coating, and thermal, but not electric conductive coating were discussed.

During the electronics workshop, several types of sensors using graphene were discussed. Possible use of graphene in wide bandgap photodetectors and high frequency microwave links were also considered.

In the workshop on energy, several energy related demonstrator and challenges were discussed:

- Enhanced performance of aluminium strips and sheets for heat exchangers for the automotive industry. Graphene would here provide enhanced heat conductivity and corrosion protection and possibly antifouling. Today, graphene coatings can be made on for example steel and there are several interested actors in various parts of the value chain. Challenges include adhesion. Graphene could potentially be included in the aluminium in the bulk of the sheet through a spraying technique. Need for support: Funding.
- Graphene enhanced concrete and composites contribute to a zero-emission bridge – a challenge initiative led by Naturvårdsverket.