

THE MAGAZINE FOR NANOTECHNOLOGY

# NANOTECH

February 2022

Issue #72

## NANOTECH IN BATTERIES

Latest market and company developments in  
nanotech for the batteries sector.

## NANOTECH PRODUCTS

All the latest nanotech product news.

## NANOTECH INVESTMENT NEWS

Latest nanotech investments, commercial  
agreements and rounds of finance.

## LATEST NEWS

Market focus on what's happening in  
nanotech research, composites, batteries,  
coatings, funding and finance.



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Graphene Magazine is published by Future Markets, the world's leading publisher of  
market information on advanced materials and nanotechnology.

# IN THIS ISSUE

## THIS MONTH

### P.04

Latest nanotech investments, financial report, investment plans, commercial agreements and rounds of finance, January-February 2022.

### P.08

Latest nanotech product news, industrial collaborations and commercial agreements, January-February 2022.

### P.09

QDs for agriculture, full color e-paper films, CNFs for food packaging coatings.

## PRODUCT FOCUS

### P.10

Nanocoatings for electronics, carbon nanotube sensors.

### P.11

News: Nanocellulose gel, nanomembranes for filtration, hydrogen production.

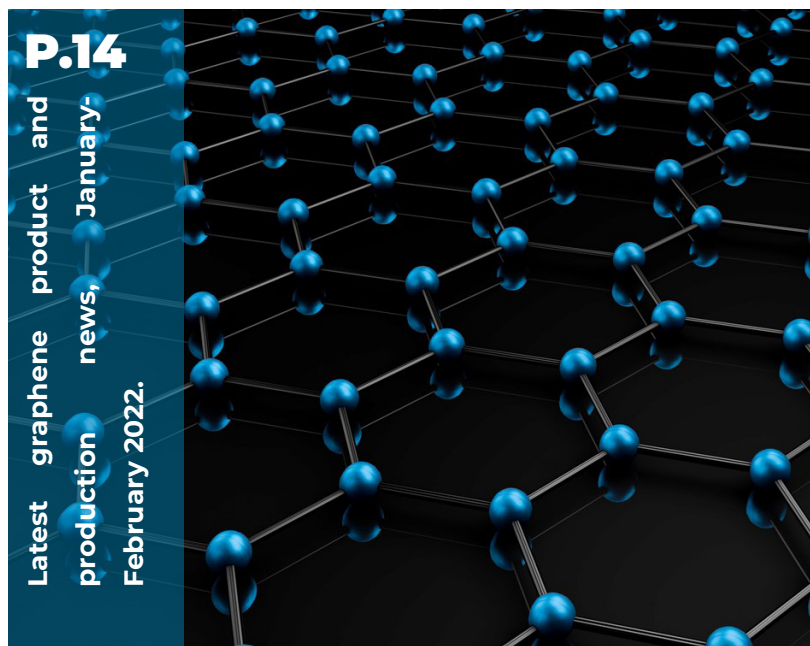
### P.12

Nanotech battery news, January-February 2022.



### P.09

Latest nanotech product and product development news including quantum dots, nanocoatings, nanocomposites, nanofibers and photonic crystals.



### P.14

Latest graphene product and production news, January-February 2022.



## GRAPHENE FOCUS

### P.14

Latest graphene investments, financial report, investment plans, commercial agreements and rounds of finance, January-February 2022.

### P. 15

News: Graphene ink heaters, environmentally friendly processing techniques to produce graphene, graphene to remove contaminants, graphene rubber.

### P. 18

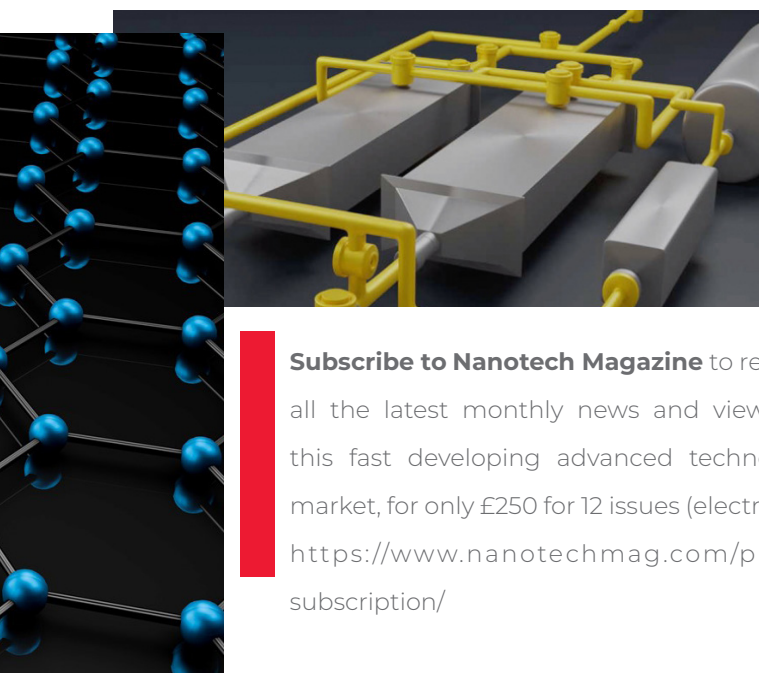
Graphene battery news, January-February 2022.

### P. 20

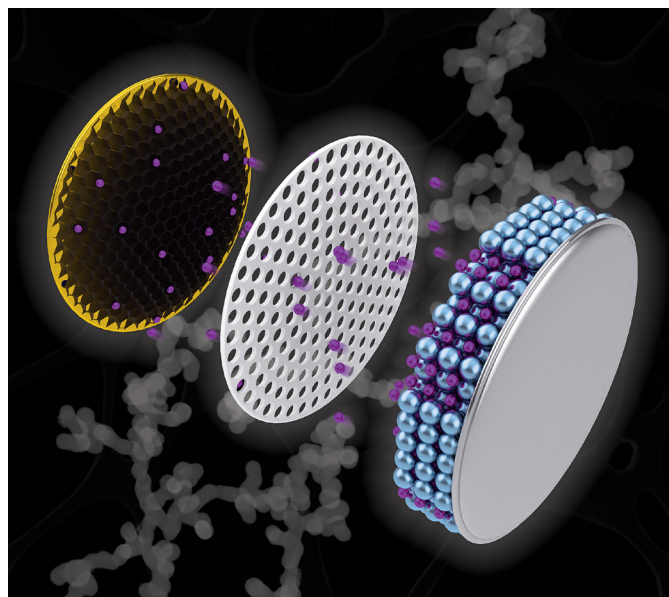
Graphene coatings news, January-February 2022.

### P. 22

Graphene buildings news, January-February 2022.



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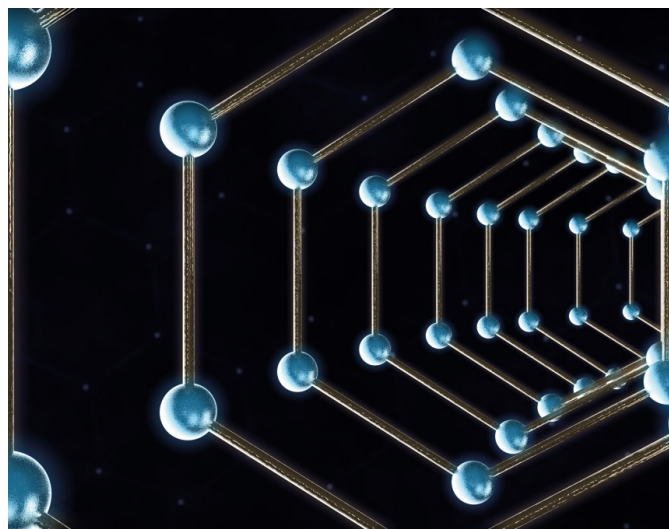
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# & Business Finance

Latest nanotech investments, commercial agreements  
and rounds of finance. January-February 2022

**Terray Therapeutics**, a nanobiotechnology company has closed a \$60 million Series A financing to advance its novel tNova platform. The financing was led by Madrona Venture Group with participation from a broad syndicate of new and existing investors, including Two Sigma Ventures, Digitalis Ventures, KdT Ventures, Goldcrest Capital, XTX Ventures, Sahsen Ventures, Greentrail Capital and Alexandria Venture Investments. This financing follows a previously unannounced \$20 million seed round co-led by Digitalis Ventures and Two Sigma Ventures. The company utilizes AI, synthetic chemistry, automation, and nanotechnology for drug discovery.

**Norske Skog Saugbrugs**, together with its research and industry partners, has been granted NOK 60 million in research funding from the **Research Council of Norway and Innovation Norway** under the Green Platform Programme. The portfolio of products to be developed aims to remove or greatly reduce the use of petroleum-



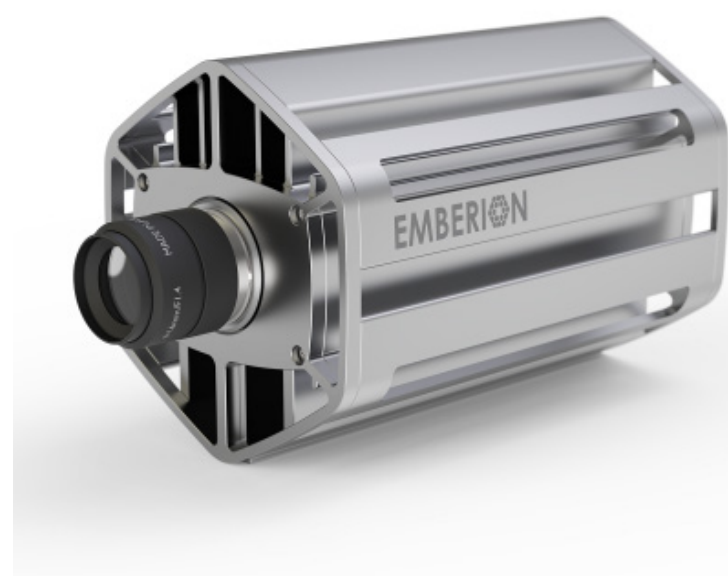


based raw materials and harmful materials, as well as to contribute to increased recycling of plastics. Through established companies and product brands CEBINA (nanocellulose) and CEBICO (biocomposite), Norske Skog Saugbrugs has conducted a number of successful research and test studies that have already resulted in new product applications with a number of customers. The nanocellulose product CEBINA has been developed during the past ten years at Norske Skog Saugbrugs. CEBINA is a natural product of fibrillated cellulose that provides improved flow properties for liquids and reinforcement in solid materials. The use of CEBINA ranges from strength gains in paper and glue to anti-drip effect in paints and fillers. After extensive marketing work, CEBINA products are now sold to several external customers in Norway and internationally. The partners under the Green Platform Programme are broadly composed of participants from raw material producers and suppliers, such as **Brenntag, Quantafuel, Replast and Norske Skog Saugbrugs**, as well as conversion companies that process thermosetting and thermoplastics in a wide range of

applications and industries, such as **Gjøco, PipeLife, NCP, Katoplast, Hallingplast and Arkeoplan**. The research institutions **SINTEF, RISE PFI and IFE** will contribute with high competence in fibre technology, nanocellulose, composites, polymers and plastics knowledge.

Israeli nanotech startup **Gauzy** has announced the raising of a \$60 million Series D to be used mainly to acquire France-based Vision Systems, which develops ADAS (Advanced Driver Assistance System) and shading solutions. Gauzy has developed LCG (light control glass) smart glass technologies with PDLC (polymer dispersed liquid crystal) and SPD (suspended particle device) that allow internal and external vehicle glass to be an active material that supports full shading and glare mitigation, temperature control, infotainment, advertising, and vehicle-to-vehicle and vehicle-to-pedestrian messaging.

**CrayoNano**, a spin-off from the Norwegian University of Science and Technology (NTNU) and specializes in UVC LED packaged chips for disinfection of water, surface and air based on a technology combining graphene and nanostructures, has received a grant of over USD\$1,565,000 from the **Norwegian Research Council of Norway** for a project titled "UV-C LED using nanowires-on-graphene". "This shows the interest and support of CrayoNano and our disruptive technology. There is a real need for better disinfection solutions, and this grant re-affirms CrayoNano's vision for a sustainable and healthier future for all," said Jo Uthus CEO of CrayoNano. The research council awarded project funding of 5 projects in the category of "radical innovation projects" totaling NOK 50 million. CrayoNano specializes in



UVC LED packaged chips for disinfection of water, surface and air based on a breakthrough, patented technology combining Graphene and nanostructures.

**BioFluidica, Inc.**, a biotechnology company developing a diagnostic platform allowing for disease management and diagnosis, it has raised over \$6 million in the initial closings of its Series B2 financing. Additional closings in this targeted \$10 million financing are anticipated following successful completion of development milestones relating to BioFluidica's handheld infectious disease detection device using nanofluidics for ultrafast high-sensitivity detection of virus particles. The funding round was led by BioFluidica's existing investor base, with participation from new investors. Dr. Steven Soper, Foundation Distinguished Professor of Chemistry, Mechanical Engineering, Bioengineering, and Cancer Biology at the Kansas University as well as BioFluidica's cofounder added "This funding will bring the advantage of advanced micro- and nanotechnology to patients worldwide. Specifically, innovative tools will evolve that can revolutionize healthcare, especially for cancer patients, through the use of liquid biopsies. In addition, new at-home tests will be generated that can assist in improving the management of current and future issues with viral infections."

**The US National Institute of Food and Agriculture (NIFA)** has awarded nine Nanotechnology for Agriculture and Food Systems grants totaling \$5.4 million to support nanotechnology-enabled solutions that improve agricultural and food production, food and nutrition security, sustainability, food safety, high value-added products, and agricultural water. This Agriculture and Food Research Initiative program embraces a wide range of research opportunities facing agriculture and food systems to advance nanoscale science, engineering, and technology for addressing critical societal challenges. Further information at <https://tinyurl.com/287hpuv9>

**NanoXplore Inc. (TSX: GRA)** has announced a \$30 million "bought deal" public offering. The company has entered into an agreement with a syndicate of underwriters led by National Bank Financial Inc. and Canaccord Genuity Corp. (together the "Underwriters") pursuant to which the Underwriters have agreed to purchase 6,522,000 common shares of the Company ("Common Shares") at a price of \$4.60 per Common Share (the "Issue Price") and offer them to the public by way a prospectus supplement for total gross proceeds of \$30,001,200 to the Company (the "Offering").

**Dragonfly Capital Corp. (TSXV: DRC.H)** has acquired **Black Swan Graphene Inc.** Black Swan is a graphene processing technology company headquartered in Toronto, Ontario. Black Swan recently purchased strategic assets related to the patented Graphene Technology from Thomas Swan & Co. Limited ("Thomas Swan"), a leading United Kingdom based specialty chemical company.

**Emberion** has raised €6 million to address the needs of the machine vision and surveillance markets for VIS-SWIR (Visible/Short Wave Infrared) cameras with broad spectrum and wide dynamic range imaging performance. Emberion is developing sensor device structures and manufacturing methods combining nanocrystalline optical absorbers with graphene-based transistors, enabling photodetection from visible (VIS, 400 nm) leading to extended SWIR 2000 nm and ultimately to 2500 nm wavelengths. The funding round was from Nidoco, Tesi (Finnish Industry Investment) and Verso Capital. Emberion offers visible-to-shortwave-infrared sensors and cameras capable of imaging from 400nm to 2,000nm. The photodetectors are built by integrating nanomaterials, such as colloidal quantum dots and graphene, on top of a CMOS readout circuit. Tuning the nanomaterials extends the sensitivity of the sensor out into the shortwave infrared. "We are disrupting multiple imaging markets by extending the

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wavelength range at a significantly more affordable cost,' Jyrki Rosenberg, CEO of Emberion, said. 'Our revolutionary sensor is designed to meet the needs of even the most challenging machine vision applications, such as plastic sorting,' he continued. 'We look forward to helping customers access new information at infrared wavelengths, thereby critically enhancing their applications beyond today's capabilities.' Emberion's VS20 camera is a VGA device with a 20µm pixel pitch, operating at 100fps and 120dB dynamic range. Emberion is headquartered in Espoo, Finland, but has its sensor development and fabrication centre in Cambridge, UK.

**Manhattan Street Fund LP.** has invested in **Avadain LLC**, a new start-up that has developed a proprietary method of manufacturing Graphene with high quality and affordable cost. Further information at <https://www.manhattanstreetcapital.com/sites/default/files/Avadain%20Graphene%20Flake%20Presentation%20%28Oct%202021%29.pdf>

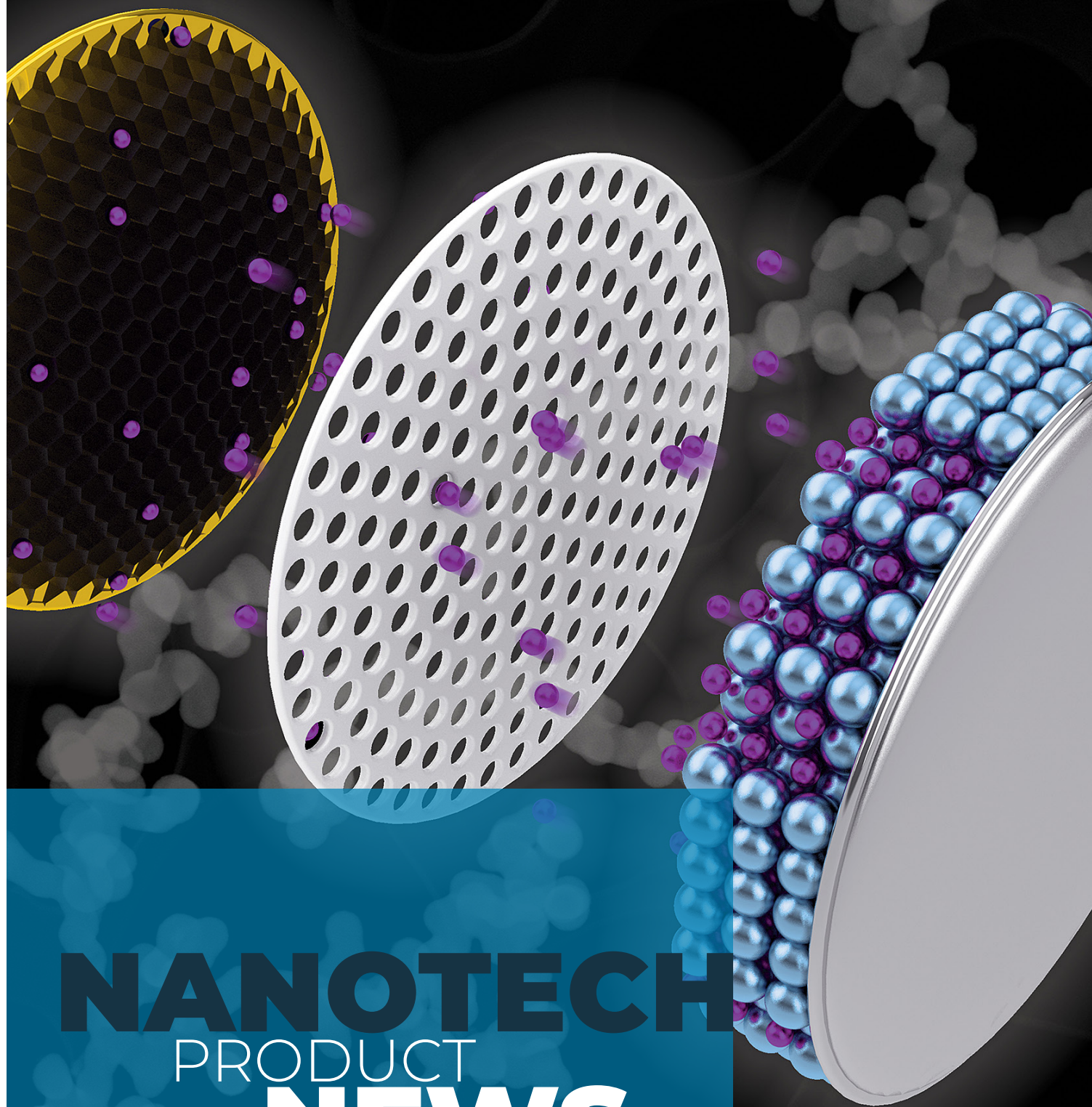
**Eastern Pacific Shipping (EPS)** is investing in nine tech start-ups. The accelerator started in 2019 and EPS has invested in 18 start-ups to date through the programme. From its third batch of hundreds of applicants EPS has now chosen to invest in seven, as well two from outside the programme. The companies include **Graphite Innovation and Technologies**. The company has developed a patented graphene-based technology to make reductions in hull-fouling.

**Paragraf**, a UK-based start-up aiming to commercialise the use of graphene in electrical devices, has raised \$60m (£44m) partly through the Government's Future Fund: Breakthrough scheme. Other investors include In-Q-Tel, Molten Ventures and Amadeus Capital Partners. Paragraf has developed a proprietary process for depositing single-atom thick, two-dimensional materials, including graphene, directly onto silicon, silicon-carbide, sapphire, gallium-nitride and other semiconductor-compatible substrates. The contamination-free technology is scalable, and compatible with existing electronic device manufacturing processes. serving the sensor, energy harvesting and semiconductor markets, Paragraf has developed its own Hall-Effect Sensors for measuring magnetic fields in demanding environments. It is now partnering with electronic device makers to enable them to take advantage of the unique properties of graphene.

**Skeleton Technologies** has secured 37.6 million euros of equity investments. The Round was led by Taavet Hinrikus, from Taavet+Sten with Nidoco AB, EIT Innoenergy, Bengt Wahlqvist, co-founder of battery charging specialist CTEK, a group of founding team members of Adyen and others joining. The investments will be aimed at further scale-up of supercapacitor production in Saxony, Germany, to meet customer demand and continuing the development of supercapacitor and curved graphene technology in new battery products.

Poland-based **nanoEMI** has raised around 250,000 Euro in its seed round, from GT Technologies, a Poland-based VC. The company says that the funds will help it scale up its production capabilities for graphene and composite materials. nanoEMI focuses on EMI shielding applications, and produces its own graphene using two different methods (exfoliation in isopropyl alcohol and in castor oil), at its own pilot production line.





# NANOTECH

PRODUCT

# NEWS

January-February 2022



**Recent nanotech products on the market January-February 2002 including quantum dot technology, carbon nanomaterials, coatings, carbon nanotubes sensors, and nanomembranes for filters.**

**UbiQD, Inc.** has released new plant trial data and launched a new website for its greenhouse industry-focused brand. UbiGro incorporates UbiQD's quantum dot technology to create a new layer of light in a greenhouse that enables growers to create a more optimal spectrum of light. The new website allows customers to learn more about the technology, review the latest data, and connect with a team of experts: <https://UbiGro.com>. UbiGro has been retrofitted into more than 30 unique greenhouse sites in seven U.S. states and seven foreign countries. Customers currently trialing UbiGro for cannabis alone have over 4.3 million square feet of greenhouse crop canopy.

**Nanobrick** has developed a full color e-paper film using photonic crystals. The company, that specializes in developing advanced materials using nanoparticles, said they achieved the feat through extensive modifications of the nanomaterials as well as process improvements which led to the development of color tunable films. [http://www.nanobrick.co.kr/en/home\\_en](http://www.nanobrick.co.kr/en/home_en)

**SkyNano Technologies**, a developer of a manufacturing process to produce carbon-based nanomaterials using CO<sub>2</sub> and electricity, has produced its first-ever output of CNTs from flue gas at the Tennessee Valley Authority's (TVA's) John Sevier Combined Cycle Plant near Rogersville. "SkyNano's demonstration is a very important step in helping utilities meet decarbonization goals in the near-term, as we work towards bringing a higher portion of renewables and low-carbon energy generation online," said Anna Douglas, CEO and co-founder of SkyNano. SkyNano's nanotubes are made by piping CO<sub>2</sub> from a smokestack into a lithium salt reactor, and then spinning it into nanotubes. The company for now is producing small amounts of research-grade nanotubes for specific clients, while looking to increase production to serve commercial clients in the coming years. Researchers have developed a cellulose nanofiber (CNF) coating



that extends the shelf life of produce and reduces waste. Developed at the **Swiss Federal Laboratories for Materials Science and Technology (EMPA)** in partnership with retailer **Lidl Switzerland**, have prepared high-quality CNFs from carrot pomace for use as a spray coating for food packaging applications. Pomace is the solid residue produced when juice is extracted from fruits, vegetables, or plants. Until now, these plant residues have been disposed of in biogas plants or directly on the field. The cellulose layer developed at Empa will be tested and



further improved over the next two years in collaboration with Lidl Switzerland and a fruit and vegetable supplier. The aim is to use the technology in all 150 Lidl stores in Switzerland. <https://doi.org/10.1021/acssuschemeng.1c06345>

**Actnano**, a startup that has developed a next-generation nanocoating that offers exceptional protection for electronics across the automotive and consumer electronics segments, has received a lead investment from BMW i Ventures in its Series B fundraising round. NanoGUARD technology from actnano is a thin nano structure sprayed directly on a desired electronic component, acting as an insulation barrier to protect the underlying component from various environmental contaminants such as water, condensation, humidity, and salt. It may be applied on connectors and antennae, as well as below massive components and CPUs, without requiring masking, unlike standard coatings.

Polish company **Nanoseen** has developed NanoseenX

# CNT SENSORS

**Somalytics**, a startup launched in November 2021 to commercialise technology developed by researchers at the University of Washington demonstrated two innovative sensor-driven devices at CES 2022.

SomaControl is a 3D gesture monitor that allows users to interact with and control digital devices via no-contact hand movements, while SomaSense is a flexible 3D sensing floor mat that detects and analyses human presence, gait and foot pressure. Both demonstration products are based on Somalytics' patent-pending Carbon-nanotube Paper Composite (CPC) capacitive sensors, which the company says deliver greater sensitivity, smaller size and lower cost than conventional capacitive proximity sensors. The CPC sensors consist of carbon nanotubes embedded within the structure of paper, which undergoes water-induced fracture to reorganise the conductive nanotube fibres parallel to one another.





nanomembranes which have the ability to trap impurities and salt in their pores and are arranged in cascades inside a cylindrical device in order to utilise the force of gravity to carry out the filtration, removing the need for the use of energy or pressure. Alongside salt, the technology is able to purify water of micro and nano plastics, bacteria, viruses and light and heavy metal ions. The company has created a mobile device which the nanomembrane technology to transform salt water into clean drinking water in the space of just 2 minutes at a cost of just 0.5 USD for 1,000 litres a day from a single installation. The device can be used in all climate zones and conditions and placed in any location, as well as areas without access to electricity. The nanomembranes are biodegradable as they are made from natural carbon compounds. Further information at <https://nanoseen.com/en/>



## NANOCELLULOSE GEL

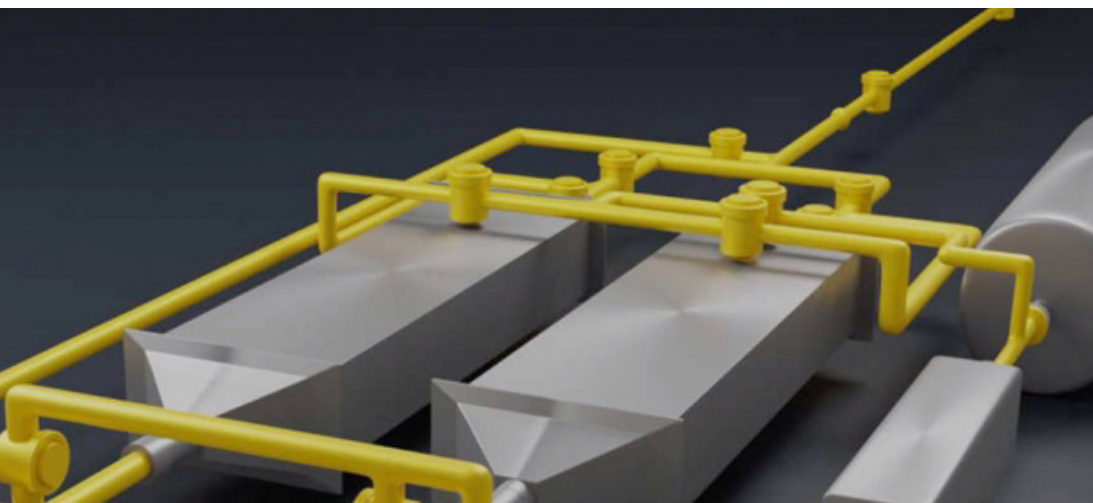


Bacterial nanocellulose start-up, **BioSmart Nano**, has developed a gel extracted from eggshells for dermic fulfilment in plastic surgeries. The start-up extracts from the eggs the same acid with high purity throughout a 'green route' and hopes to pave the way for the next generation of dermal fillers. The project has received financing from Fapesp (São Paulo Research Foundation) in partnership with the Canadian company, Coesys. BioSmart Nano was founded in Araraquara city, São Paulo, in 2016, and has been working with the Canadian partners since 2020 to develop the new route for extracting the hyaluronic acid from eggshells sustainably. "We were able to do this with organic solvents, which are not so aggressive and do not produce so much waste that could harm the environment. With this new extraction method, we are working on a 'green' route to obtain hyaluronic acid," said Héliida Barud, CEO of BioSmart Nano. <https://www.biosmartnano.com/>



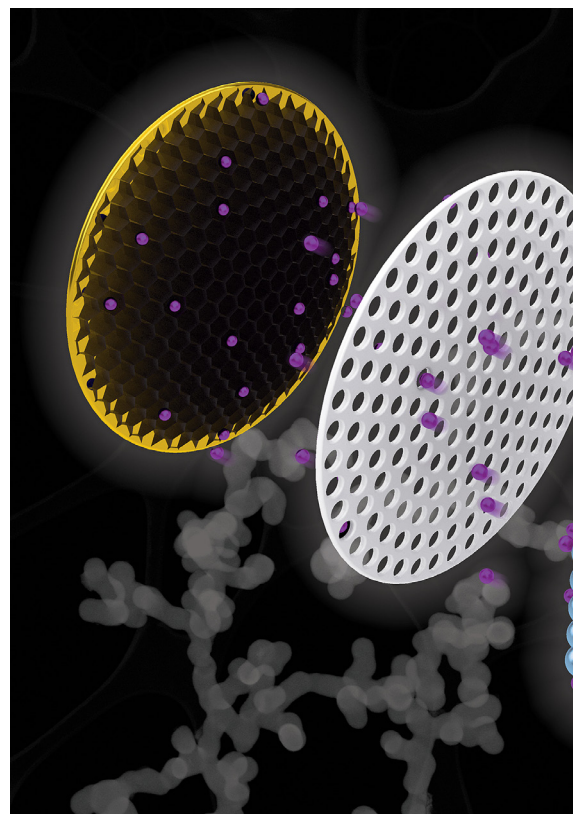
US nanotechnology company **Damorphe** is developing a hydrogen production technology using a rare earth oxide alloy that dissolves in water, which it says has the potential to deliver clean hydrogen at \$1/kg. The company, which specializes in nanomaterials for niche applications from aerospace and defense, to energy and healthcare, is working with partners to develop a prototype 1 mt/day demonstration facility in California, which could produce hydrogen for truck refueling. Further information at <https://damorphe.com/>

# NANOTECH BATTERY NEWS



**R**esearchers at **MIT** have designed a specialized battery that can remove carbon dioxide even at small concentrations from air. The system can process carbon dioxide at any concentration level, even down to the roughly 400 parts per million currently found in the atmosphere. This is different from most current methods of removing carbon dioxide from air. Other methods require a higher concentration of the CO<sub>2</sub> in the air, such as what's present in the flue emissions from fossil fuel-based power plants. The device is essentially a large battery that absorbs carbon dioxide from

the air, or another gas stream, passing over its electrodes as it is being charged up. As it is being discharged, it releases the gas it collected. That electro-active polymer and conductive material is a compound called polyanthraquinone, which is composited with carbon nanotubes. This gives the electrodes a natural affinity for carbon dioxide so they can readily react with its molecules in the airstream or feed gas, even when it is present at very low concentrations. The researchers have set up a company called **Verdorex** to commercialize the process and device, and hope to develop a pilot-scale plant for





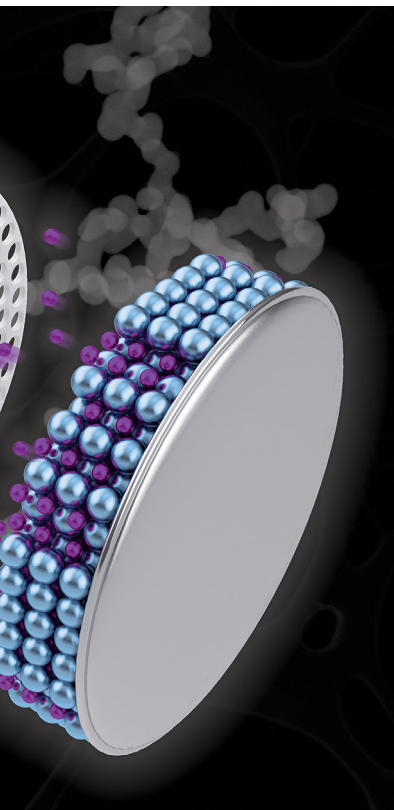
carbon-dioxide processing within the next few years. Further information at <https://verdox.com/>

**A**mprius has shipped the first batch of what it claims are the most energy-dense lithium batteries available today. These silicon anode cells hold 73 percent more energy than Tesla's Model 3 cells by weight, and they take up 37 percent less volume. Amprius says the batteries' impressive performance is due to its silicon nanowire anode technology.



**S**ilicon can store some 10x more lithium than graphite, but it tends to swell and crack, drastically reducing cell life. Amprius says that when you form the silicon into porous nanowires, arranged as a kind of forest of longer wires with shorter ones in between, the silicon is able to tolerate swell and resist cracking, extending the life of the cell to the point where silicon anodes can become a competitive technology. The company says the silicon nanowires are rooted right into the substrate of the anode, so conductivity (and thus power) is high. It says the cell cycle life is "excellent" and "continually improving," although it doesn't put any numbers on it, and it also says the anode is the only part of the battery that changes; the rest can be produced using existing manufacturing methods and components. Further information at <https://amprius.com/>

## NANO ONE BATTERY



**N**ano One has successfully completed Phase One of its advanced lithium-ion battery cathode materials coating development agreement with **CBMM**, a leading supplier of niobium products and technology. 'Nano One has successfully demonstrated the use of CBMM's niobium,' said Nano One CTO Dr. Stephen Campbell, 'to form a protective coating on our single nanocrystal NMC cathode active material. This coating is designed to enhance durability, and our success on this first milestone strengthens the supply chain relationship between CBMM and Nano One while providing yet another demonstration of the flexibility of

Nano One's patented One-Pot process.'

**N**ano One's patented One-Pot process adds a cost effective niobium coating on each individual nanocrystal to protect the cathode from deleterious side reactions than can otherwise cause rapid performance degradation. The One-Pot process enables this coating to be formed without adding process steps or costs, and the coating can significantly increase the durability of cathode materials in lithium-ion batteries. The niobium coated single crystal cathode materials are applicable to both conventional liquid electrolyte cells and advanced solid state electrolyte cells. <https://nanoone.ca/>



# GRAPHENE

PRODUCT

# NEWS

January -February 2022



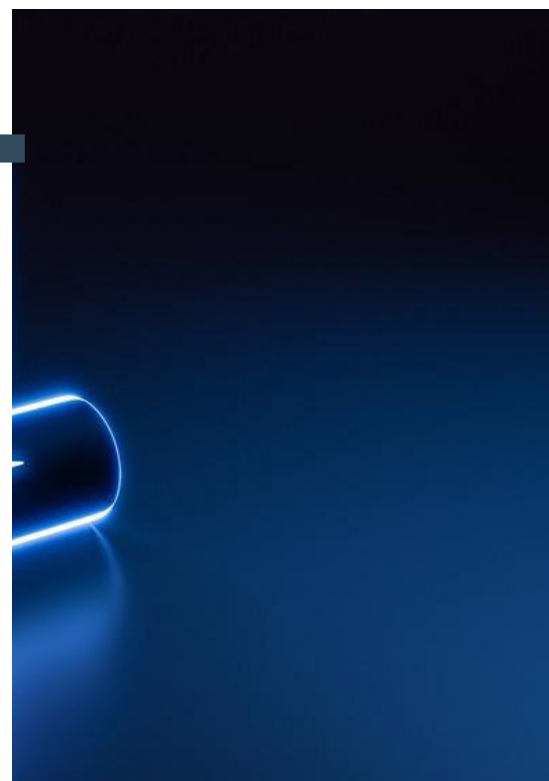
**Low-cost, high volume production and ease of integration is crucial for the development of widespread application of graphene-enabled products. This month we look at recent developments and breakthroughs.**

# LAB TO PRODUCT

**Haydale Graphene Industries PLC** is collaborating with **Cadent Gas Ltd and Energy Innovation Centre** to develop graphene ink-based heaters for low-power hot water. The £135,000 project will initially develop an operational pre-product prototype. The project will seek to develop low-power option heating for water which is less costly than other gas-free alternatives such as fan heaters and hot plates. Haydale Chief Executive Officer Keith Broadbent says: "We look forward to working with Cadent and the Energy Innovation Centre on the use of functional graphene inks in the energy supply market. Our graphene-based heater technology offers the potential of a low-power solution for use in people's homes to keep them safe and warm when there is an interruption to supply."

**Minnova Renewable Energy** is undertaking research and development efforts to include analysis of biochar derived from pyrolysis to improve environmentally friendly processing techniques to produce graphite and graphene. Biochar already has demonstrated commercial uses ranging from soil enhancement to filtration systems, but more recently offers potential to be a natural source of graphene. The planned research initiative will inform their strategy to maximize green hydrogen production and produce a high quality biochar with potential to be transformed to a commercial renewable graphene product.

**G6 Materials** has secured an exclusive five-year supply agreement with an EU-based global microconnector company. G6 shall supply its products for a variety of smartcard applications. The company's



subsidiary **Graphene Laboratories** had also recently entered into a Testing Services Agreement with the U.S. Army Engineer Research & Development Center to assess the ability of graphene oxide materials to solve environmental challenges through the adsorptive removal of contaminants.

Swedish companies **2D Fab** and **EcoRub** are collaborating to using graphene to strengthen recycled rubber and polymer. EcoRub has been developing materials and products out of recycled rubber for more than 20 years. 2D fab is a large-scale



manufacturer of green graphene.

**Haydale** has been awarded a SMARTCymru grant from The Welsh Government that will enable the Company to progress with the development of its anti-counterfeiting ink technology, PATit. The Project has a total cost of £169,000 and is expected to take six months to complete. The SMARTCymru grant, which is part-funded by the European Regional Development Fund, will cover about 50% of the anticipated project costs.

**realme** has launched its new GT 2 smartphone series, marking the company's first steps into the premium segment. The GT 2 series incorporates a 3D liquid-cooled VC and graphene sheet cooling technology.

**VoltaXplore**, a joint venture formed by graphene producer **NanoXplore** and partner **Martinrea International** to develop electric vehicle (EV) batteries enhanced with graphene, will take part in Canada's Project Arrow. Canada's Automotive Parts Manufacturers' Association has decided to build an electric SUV almost entirely from

# LOOP GRAPHENE

The National Grid has signed up to trial Levidian Loop, a decarbonisation device, as part of research designed to boost the UK's ability to transport and use hydrogen in the UK's gas supply.

Levidian (formerly Cambridge Nanosystems) LOOP uses plasma technology to separate methane into its constituent atoms: carbon, locked into high-quality graphene, and hydrogen, which can either be used immediately or stored for future use. Backed by Network Innovation funding, the project could allow National Grid to reinforce parts of the gas pipe network by using graphene as a corrosion-resistant internal coating, making it more able to carry increased quantities of hydrogen and less likely to crack. Reinforcing the network using graphene could increase the country's ability to transport and access clean hydrogen, allowing existing infrastructure to be repurposed, minimising disruption and making the switch to hydrogen easier for consumers and businesses.



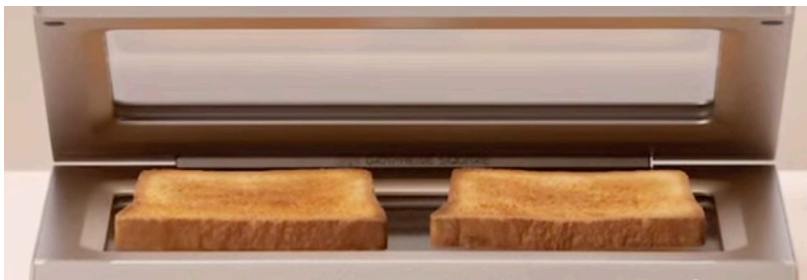
Canadian sources, including the battery, in the new Project Arrow.

Researchers from the **ARC Centre of Excellence for Electromaterials Science (ACES)**, **UOW** and the **Australian National Fabrication Facility (ANFF)** have developed a new form of graphene, called Edge Functionalized Graphene (EFG), that is both highly conductive and processable. The researchers are working with **Sicona Battery Technologies**, a private next-generation battery material company, to demonstrate scale-up of production. Sicona has executed binding agreements with UOW for the acquisition of all its intellectual property related to EFG.

**AspenX**, a premium retail brand recently launched by the Aspen Skiing Company, has collaborated with **Prada** on a graphene-enhanced capsule collection. The six-piece range of performance outerwear mixes Prada Linea Rosso's Extreme-Tex waterproof layer with a graphene padding to regulate body temperature, and distinctive graphic black-and-white designs by artist Paula Crown.



## GRAPHENE TOASTER

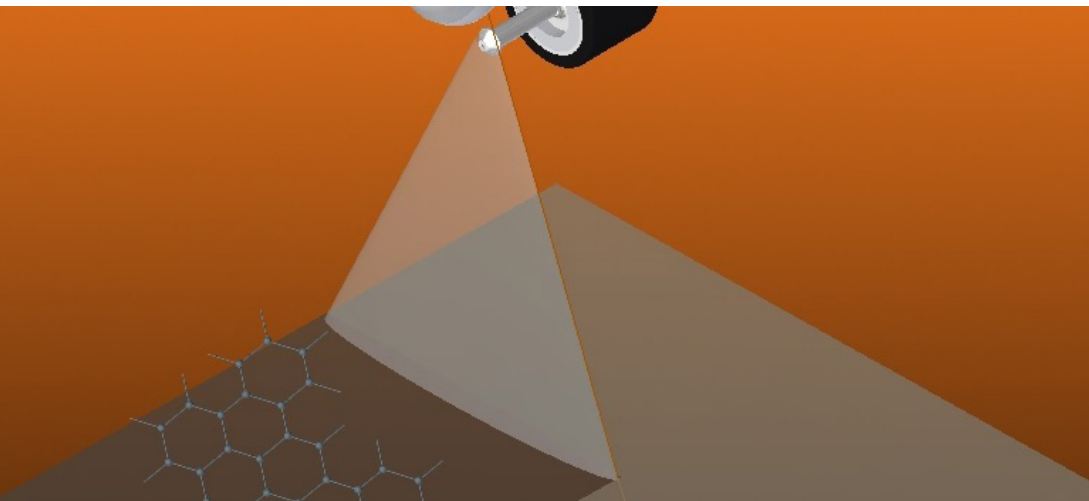


At CES 2022 in Las Vegas, Korean graphene producer **Graphene Square** unveiled the Graphene Kitchen Styler. The transparent toaster utilizes graphene technology to heat the device and toast bread, by conducting electricity. The company aims at achieving a perfect toast with only half of the power consumption. As the toaster is transparent, it lets the users keep an eye on the level of bread toasting. The kitchen styler is foldable and expandable due to dual warming/cooking plates. According to the company, graphene can reach up to 200-degrees Celsius in just 90 seconds. The company expects the product to hit the market in 2023. Graphene Square's uses a proprietary chemical vapor deposition (CVD) method for the mass production of graphene. Further information at <https://www.youtube.com/watch?v=odr2X-oDWbg> and <http://www.graphenesq.com/>

UK-based **AEH Innovative Hydrogel Limited (AEH)** has received a £3.5 million investment from agri-tech leader **Terra Sana Holdings**. AEH, established in 2018 and located at **Manchester University's GEIC center**, develops a food-based fully recyclable hydroponic gel, based on graphene, which is designed to reduce food production costs, improve quality and lower environmental impact. AEH will use the funds to fully develop its vertical farming system and to set up a manufacturing facility in Greater Manchester. This investment builds on a £1 million investment already made by Innovation UK to AEH.



# GRAPHENE BATTERY NEWS



**A**lpine 4 Holdings, Inc. subsidiary, ElecJet, has launched its AX and G-AX Class of solid-state batteries. ElecJet has completed its initial demonstration product run of its AX Class 31Ah Solid State Batteries. The company will be distributing these batteries as test samples to various corporations upon request. The AX Battery Class is a Ceramic Oxide solid-state battery and comes in the form of a 31Ah Solid-State Battery and a 10Ah Solid-State Battery. The AX battery was designed for ultra-energy dense applications that need a powerful battery solution but not necessarily the

ultra-fast (8C+) charging that the G-AX Class Batteries can provide. Both the G-AX and AX use graphene in the battery cells but for different purposes and at different levels of the battery's design. <https://elecjet.com/>

**F**irst Graphene (FGR) has been awarded funding from Innovate UK EDGE to progress development work on its supercapacitor graphene hybrid materials with a Research and Technology Organization (RTO) based in the United Kingdom. The funding will be used to progress the development of novel supercapacitors using First Graphene's unique hybrid-



## The use of graphene in battery formats allows greater flexibility for incorporation into various products

graphene materials and optimized protic ionic liquid electrolytes. <https://firstgraphene.net/>

**G** r a p h e n e  
Manufacturing Group  
(GMG)

graphene aluminium-ion batteries ("G+Al Battery") 2032 type coin cell prototypes have been sent to a number of prospective customers around the world. GMG reports that coin cell testing to date has demonstrated that the GMG 2032 type G+Al Battery coin cell prototypes are fully rechargeable in several seconds, retain capacity for several thousand charge and discharge cycles, are

non-flammable, and are relatively non-toxic and almost fully recyclable. These characteristics compare favorably against typical rechargeable Lithium-Ion 2032 type coin cells which take 3-6 hours to recharge, are toxic and can be quite harmful if ingested, are difficult to recycle, are flammable under certain conditions, and degrade more rapidly in performance. Further information at <https://graphenemg.com/>

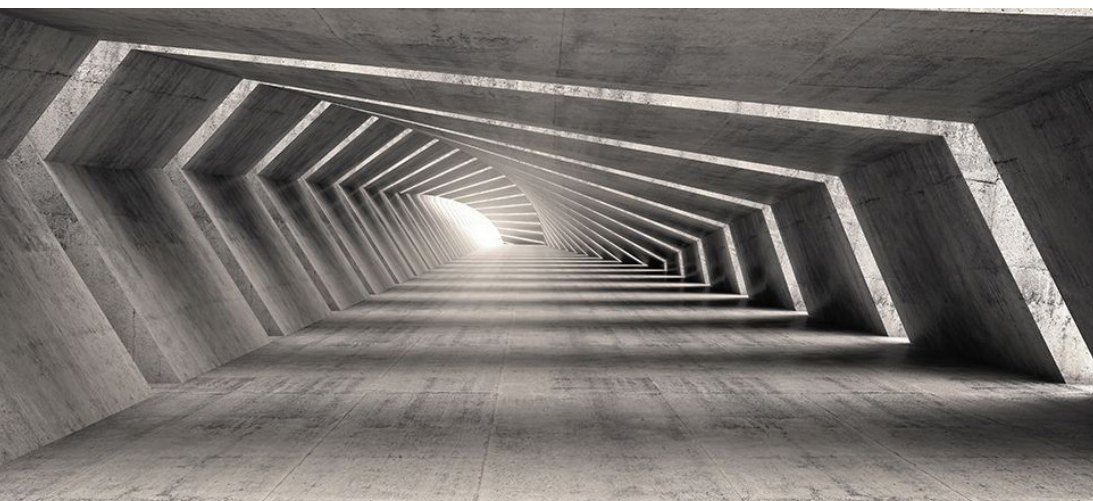
## LYTEN BATTERIES



**L** yten, a company developing lithium-sulfurbatterytechnology based on Lyten 3D Graphene, has secured a prototype Other Transaction (OT) agreement in support of the **Defense Innovation Unit (DIU)** around high-specific energy storage and management solutions. A core objective of the agreement is to demonstrate a lithium-sulfur (Li-S) battery solution that will significantly increase the duty cycle of small satellites for the U.S. Space Force, which is one of many applications for the new Li-S battery technology. The ultimate goal of the effort is to develop a lithium-sulfur rechargeable battery capable of three times the energy storage capacity

of current lithium-ion (Li-ion) batteries, enabling the use of higher duty cycle spacecraft and those that function longer during an eclipse. Lyten has also received a contract from the **U.S. Department of Defense's (DoD) National Security Innovation Capital (NSIC)** program to aid in expanding the capacity of its domestic battery prototype manufacturing and production capabilities. The funding from NSIC will help reduce the time to market for Lyten's LytCell™ lithium-sulfur (Li-S) batteries by increasing the number of cells that can be produced per year at its battery cell pilot production line, currently being built at its headquarters in San Jose, California. <https://lyten.com/>

# GRAPHENE COATINGS NEWS



**S**tanvac-Superon Group, an India-based manufacturer of industrial repair and maintenance solutions, has launched a conductive coating incorporating **Applied Graphene Materials (AGM)**'s Genable graphene dispersions, for use on industrial power transmission equipment. Following successful development and testing, the new protective, conductive coating incorporating AGM's A-GNP35 graphene dispersions will reduce contact resistance in coated copper and aluminium electrical cable joints to reduce the power lost over the connection. Using the graphene-based 8079 (A)

Power-Plus coating, a 30-50% reduction in contact power loss is reportedly achieved, offering significant energy savings over time. Stanvac-Superon Group expects the product to be used for power transmission, electrical distribution, and railways, as well as other high energy consumers such as steel mills, smelters, and refineries.

England's **Environment Agency (EA)** has also successfully completed its first application of AGM's harsh environment anti-corrosion product to one of its flood defense assets on the North East coast of England. The coastal flood defense gates were coated with AGM's new graphene-





## Graphene coatings protect copper from corrosion, chemical attacks, and thermal oxidations.

enhanced Genable CX-based anti-corrosion primer.

**Tata Steel** has developed a new product, a few-layer film of rGO along with its collaborators at **CeNS**, Bengaluru. The company is now starting to mass-produce the films and offer them to application developers. The rGO film is produced (using a modified CVD process) on copper. The film's average thickness is 5-10 nm and offers a corrosion rate of 0.02 mm/year (Tafel) and a water contact angle of ~ 97°. These properties make the film suitable to protect copper from corrosion, chemical attacks, and thermal oxidations. It also makes

copper hydrophobic and can act as an antibacterial surface.

After six months of testing **Sparc Technologies** announced its graphene-based additives was found to offer up to 40% improvement in the anti-corrosive performance of atmospheric epoxy coatings. The company used commercially available epoxy coatings available from leading coatings manufacturers.

## GRAPHENE SHIPCOAT



**Graphite Innovation and Technologies (GIT)** uses graphene as the base for its strong, slippery and non-toxic hull paint. The coating helps prevent marine fouling – when aquatic organisms such as barnacles stick to the hull – thus improving the flow of water against the vessel, making it more efficient. Now, the coating will be heavily tested on large vessels operated by Oceanex and Baffin Fisheries.

“The vessels operated by Oceanex and Baffin Fisheries are larger vessels that move at a much higher speed than the small inshore fishing vessels previously tested under our contract with Transport Canada,” said Mo AlGermozi, President of Graphite Innovation and Technologies. “It

is so much more comparable to the large transport vessels that we target as key customers, as transport fleets are more interested in reducing fuel costs and improving their environmental impact.”

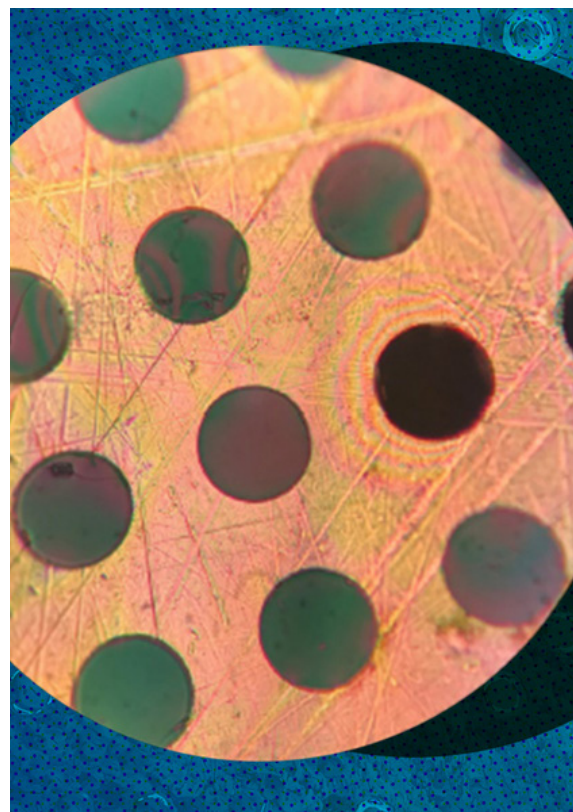
After its return to service at the end of January, quarterly underwater surveys will be carried out to compare the results with the existing paint. “We think it will be obvious to see how well this works compared to the other coating that is on the ship today,” said Matthew Hynes, executive vice president of Oceanex. A total of nine ships will be coated as part of the federal government's Ocean SuperCluster innovation program.

# GRAPHENE BUILDINGS NEWS



**GtM Action** is working with pre-fab concrete manufacturer **C&O Concrete Limited** to bring graphene-enhanced concrete to market. GtM Action has distribution rights for graphene materials manufactured by Australia-based First Graphene, which was reportedly found (in studies carried out by First Graphene, industry and a range of global research institutions) to provide up to 59% improvement in compressive strength and 33% improvement in tensile strength of concrete. Working with C&O Concrete had enabled GtM to quickly test graphene on a larger scale with batch sizes up to 1.3 cubic meters. This enabled quick turnaround of testing in a variety of products including small floor slabs, landscape products and explosive goods sheds.

**First Graphene Ltd** (ASX:FGR, OTCQB:FGRAPH) has formed a collaboration agreement with global construction chemicals manufacturer **Fosroc International Limited** for the development of PureGRAPH® graphene-enhanced cement additives or grinding aids. Both parties will contribute scientific and industry knowledge at their own cost, with First Graphene



Graphene is being increasingly utilized in hard wearing outdoor shoes and heated textiles.

providing access to its PureGRAPH® product range, formulation and dispersion process technologies, while Fosroc will take responsibility for additive raw material supplies and formulations, mixing and dispersion and extensive laboratory trials. The company has also been awarded a UK Government grant to develop high performance graphene-enhanced cement. The grant was awarded by the UK Government's innovation agency, Innovate UK to the consortium, which includes construction materials group **Breedon Cement Ltd**, construction and regeneration group **Morgan Sindall Construction &**

**Infrastructure Ltd**, and the **University of Manchester's Department of Mechanical, Civil and Aerospace Engineering**. The project will develop a new graphene-enhanced cement (GR-CEM) product using PureGRAPH® additives. PureGRAPH® products have been shown through external testing at international standards to enhance compressive strength by 34% and tensile strength of cement mortar by 27%, reducing the need for unsustainable clinker additives.

## NEW 2D MATERIAL



Using a novel polymerization process, **MIT** chemical engineers have created a new material that is stronger than steel and as light as plastic, and can be easily manufactured in large quantities. The new material is a two-dimensional polymer that self-assembles into sheets, unlike all other polymers, which form one-dimensional, spaghetti-like chains. Until now, scientists had believed it was impossible to induce polymers to form 2D sheets.

Such a material could be used as a lightweight, durable coating for car parts or cell phones, or as a building material for bridges

or other structures. The researchers have filed for two patents on the process they used to generate the material. The new polymerization process generates a two-dimensional sheet called a polyaramide. For the monomer building blocks, they use a compound called melamine, which contains a ring of carbon and nitrogen atoms. Under the right conditions, these monomers can grow in two dimensions, forming disks. These disks stack on top of each other, held together by hydrogen bonds between the layers, which make the structure very stable and strong. The new material is called 2DPA-1.