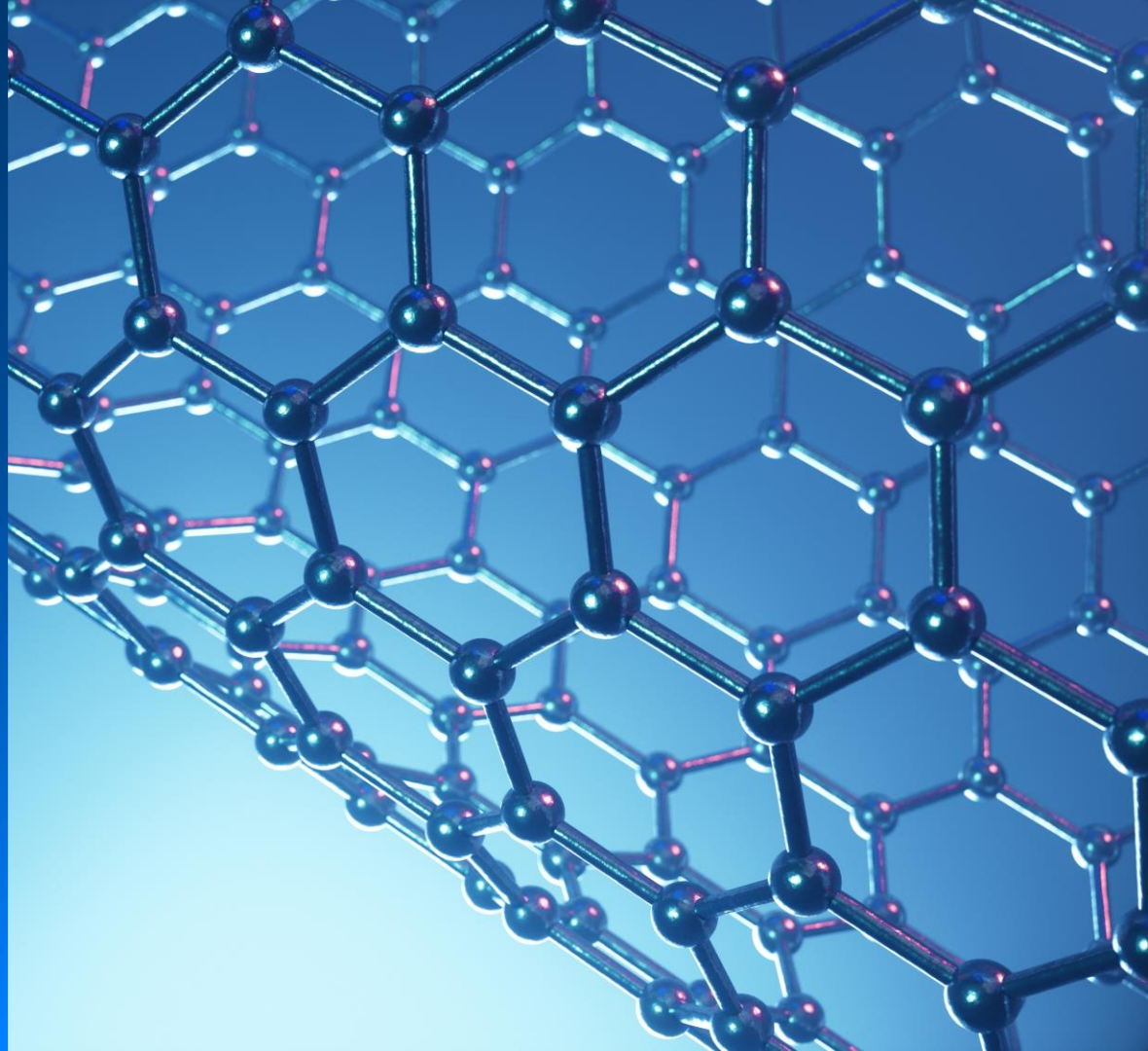


# GRAPHENE

## Manufacturing in 2022

PRESCOUTER 2022



## Suppliers of graphene - Timeline



2015

Small, privately-held companies

Estimated total production capacity



2020

~800 tons/year



2022

~20,000 tons/year

Currently

# Graphene production

has advanced immensely in under a decade, unlocking new commercial applications and technologies.

In 2015, all suppliers of graphene were small, privately-held companies. With the development of reliable cost-effective processes to mass-produce large quantities of graphene, such as industrial exfoliation methods and chemical vapor deposition (CVD), and educate the customers on how to use this material, the gap between R&D and commercialization has been reduced, enabling new products and technologies. Even so, **in 2020 our findings estimated a total production capacity of around 800 tons/year, and the companies were located in a few main areas** (mostly Canada, Australia, and the UK).

This Intelligence Brief gathers updates on 23 companies previously profiled and/or mentioned in our reports, summarizing the key milestones for graphene producers. **Currently, the total production capacity is estimated at around 20,000 tons/year.** Only 2 out of the 23 companies went out of business, while two others **increased their production by over 150% each.** Five additional players were identified and profiled. One supplier was interviewed to address technical questions regarding manufacturing capacity, production methods, and specific product applications amongst others.

# Key Takeaways

## 23 Previously profiled companies



### Products

In the last two years, **27 new products** with graphene have been launched



### Growth

8 companies partnered or made collaboration agreements with companies and R&D institutions



### News

Comet Resources and Talga Resources entered this space betting on graphene-enhanced lithium batteries



### Grants

At least **\$408M were raised** across companies in the last two years

## 5 Additional companies founded between 2007 and 2013



### Products

Besides graphene powder, 3 of them produce graphene films and 2 produce graphene-enhanced batteries



### Capacities

Ranging from **~4 to 1,000 tons/year**



### Production Method


All of them produce graphene by **exfoliation methods** and only two also by CVD



### Location

Three of them are located in China, one in Brazil, and one in the US




# Updates on graphene players covered in previous reports

Company												
Company Size	N/A	11-50	11-50	2-10	2-10	11-50	51-200	11-50	11-50	11-50	2-10	11-50
Year Founded	2011	2010	2007	2012	1993	2005	2011	2016	2009	2011	2014	2006
Headquarter	China	UK	Australia	Norway	Australia	Italy	Canada	Australia	USA	Canada	Spain	Malaysia
Market Cap (US\$ million)	N/A	18.3	175.1	N/A	2.5	83.9	9.9	71.9	18.1	N/A	N/A	2.6
Capacity per year	200,000 m <sup>2</sup> (in 2014)	N/A	N/A	10,000 m <sup>2</sup> (in 2016)	N/A	30 tons	4,800-10,000 tons (in 2017)	100 tons	N/A	N/A	N/A	N/A
Production Method	CVD	Solution-based Decomposition Of Metal Alkoxide	Electronic Exfoliation	CVD	Electronic Exfoliation	Thermal Expansion followed by Exfoliation	Exfoliation	Electroch. Exfoliation	CVD and Chem. Exfoliation	Exfoliation	Epitaxial Growth	Chemical Synthesis
Company Category	Producer	Producer	Application developer	Producer	Mining	Producer	Mining, Producer, & Application Developer	Mining & Producer	Application Developer	Producer	Producer	Producer
Current Status	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Out of Business 2019/2020	Out of Business 2021

# Updates on graphene players covered in previous reports

Company	 Graphenea	 graphensic	 haydale	 nanoplore	 talga	 Thomas Swan	 Versarien	 xgSciences	 zentek	 williambythe Quantity for sample GOgraphene	 LayerOne
Company Size	11-50	2-10	51-200	201-500	11-50	51-200	51-200	51-200	2-10	51-200	11-50
Year Founded	2010	2011	2010	2011	2010	1926	2010	2006	2008	1845	2005
Headquarter	Spain	Sweden	UK	Canada	Australia	UK	UK	USA	Canada	UK	Norway
Market Cap (US\$ million)	N/A	N/A	28.1	700.0	49.2	N/A	61.1	N/A	292.3	N/A	N/A
Capacity per year	1 ton (in 2016)	N/A	30 tons (in 2021)	4,000 tons (in 2020)	1,000 tons (in 2018)	1,000 tons (in 2021)	10 tons (in 2021)	300-600 tons	40 tons (in 2019)	N/A	0.3 tons (in 2015)
Production Method	CVD	Epitaxial Growth	Plasma Exfoliation	Liquid Exfoliation	Electroch. Exfoliation	Liquid Exfoliation	CVD and Exfoliation	Chem. and Mec. Exfoliation	Chem. and Mec. Exfoliation	Chemical Exfoliation	Chemical Synthesis
Company Category	Producer & Application Developer	Producer	Producer	Producer	Producer & Application Developer	Producer	Producer & Application Developer	Producer & Application Developer	Mining & Application Developer	Producer	Producer
Current Status	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active	Active

# Additional 5 players we found on the market

Company	 BoomaTech	 The Sixth Element Inc.	 GLOBAL GRAPHENE GROUP	 墨西科技 MORSH	 KNANO
Company Size	2-50	51-200	51-200	11-50	51-200
Year Founded	2013	2011	2007	2012	2010
Headquarter	Brazil	China	USA	China	China
Capacity per year	3.6 – 6 tons	1,000 tons	300 tons	500 tons	200 tons
Production Method	Chemical electro-exfoliation	Exfoliation and CVD	Exfoliation and CVD	Exfoliation	Exfoliation
Products	Powder, flakes, & graphene-enhanced batteries	Powder, suspensions, & films	Powder, dispersions, films, & graphene-enhanced batteries	Powder, films, pastes, & coatings	Powder, nanoplatelets powder, & pastes
Current Category	Producer & Application Developer	Producer	Producer & Application Developer	Producer & Application Developer	Producer

# Introduction

A look at the current graphene market

# In 2019, the global graphene market size was estimated to be **91.3M USD**

The global graphene market size is projected to grow from 620M USD in 2020 to 1,479M USD by 2025; it is expected to register a CAGR of 19%. Asia-Pacific continues to dominate the market (60%) due to the increase in demand from the electronics and healthcare industries.



Global value of the graphene market from 2020 to 2025. Source: [Markets and Markets](#)

## Driving Factors:

The 3 main drivers of the graphene market are:



**Next generation transistors, sensors, capacitors, etc.**

Graphene is used as a coating to improve the touch screens in wearable and flexible electronic devices. Graphenea, profiled in previous reports, is supplying several types of graphene-based field effect transistors for applications in biosensing, microelectronics, and rapid testing.



**High conducting thin films and ink**

The very high conductivity of graphene is used in making next-generation computer chips which can conduct even at room temperature. [Graphene-Xt](#), an additional company that is located in Italy, is supplying graphene inks and coatings of only a 10 nm thin layer of graphene that can withstand high temperature and pressure.

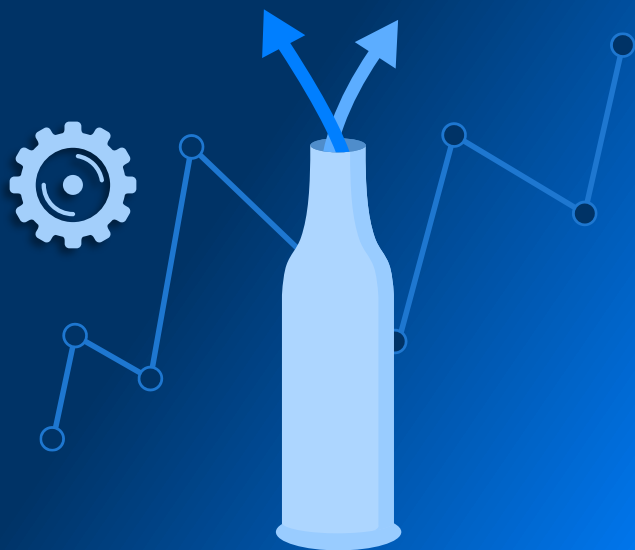


**Graphene batteries and graphene electrodes for Li-ion batteries**

Graphene batteries and graphene aluminum-ion batteries are already present in the market and are still in the best interests of the research world to further develop them to reach theoretical capacities.



# Bottlenecks and Challenges



The global graphene market witnessed a decline of 27% in the year 2020 due to the impact of the SARS-CoV-2 pandemic. This has created a huge challenge within the companies to bring back the production rate by keeping the budget less since some **equipment used in the production of graphene is expensive**. Given that the material must have consistent properties for any application, **producing single-layer graphene with the same properties in each iteration is another challenge and scientists are working on removing graphene from the substrate**.

Concerning the properties of graphene, it is **inflammable in nature**, which requires massive precautions to be taken. Graphene oxide (GO) nanoparticles are toxic to humans and animals. They are also very mobile through streams and lakes and can cause a **negative impact on the environment** if released.

**The graphene industry has done only a small amount of work in terms of regulations and standards**. Several companies are producing various types of graphene, which is causing confusion in the industry. This factor has resulted in fake graphene in the market, which is difficult to realize at the product stage. This is leading to diminishing trust among end-users.

The lack of a skilled workforce is another hurdle that the industry is facing.

Despite being an emerging technology, the graphene industry already has **more than 300 players** in various categories

#### VALUE CHAIN PLAYERS

##### Graphite Mining

Companies mining graphite and also involved with graphene.



##### Graphene Producers

Companies focusing on producing graphene with graphite as a source ('top down' production methods) or fabricating graphene using carbon molecules as building blocks ('bottom up' methods).



##### Application Developers

Companies developing graphene-based products.



##### Equipment Suppliers and Service Providers

Companies providing services or equipment to the graphene industry, such as R&D labs and machinery suppliers.



# Applications: How can companies use graphene?

Graphene is the thinnest material (1 atomic layer thick) known to humans, which makes its applications endless. Graphene can be used in simple applications like a conductive additive in electronics all the way to the most complex applications like building space armors and bullet proof armors.



## Chemicals

As part of composite materials, in boats or automotive parts, to decrease weight, absorb impact, etc. Or as an additive in formulating polymeric-based products such as car waxes, etc.



## Hygiene

Incorporation in textiles or safety boots, with an antimicrobial purpose, or in membranes for water sanitization, industrial filtration, etc.



## Coating

Usage in inks, paints, primers, and coatings to protect a substrate against harsh chemicals, preventing corrosion/rust in highly aggressive environments as an anti-static agent, etc.



## Building Materials & Construction

As reinforced concrete to improve strength, in cements to reduce clinker factor (low-carbon footprint), etc.



## Packaging

In high barrier monolayer films for food packaging as simultaneous oxygen, water vapor barriers, etc.



## Electronics

In integrated circuits in electronic components and as a precursor material in lithium-ion battery anodes used in electric vehicles, providing thermal/heat dissipation, electrical conductivity at room temperature, etc.

# What's new?

Updates on previously profiled companies



# 2D Carbon Tech



2020

Dec

Invited to join the [Triumph Group](#) to expand multi-field cooperation and the exchange of graphene applications



2021

Jan

Announced application of graphene in an [electric heating film for residential floor heating](#)



# Applied Graphene Materials (AGM)



APPLIED  
GRAPHENE  
MATERIALS

2021

Jan

Raised about £6.0M in a fundraising to accelerate the growth of the business



Feb

Announced the application of graphene in a graphene-based **car wax** launched by **Infinity Wax**



Mar

Announced the application of graphene in graphene-based **car sealants** launched by Constellation Chemicals



Apr

AGM's distribution partner, **Maroon Group**, acquired by Barentz International



May

Announced the application of graphene in graphene-based **bike detailer** launched by **Tru-tension**



Jul

Launched a new product line series, Genable 1700, which are **eco-friendly graphene nanoplatelet dispersions**



Aug

Received £47,500 funding to install a new paint and a coating spray booth facility



Dec

Received a UK patent for graphene nanoplatelets use in **water-based anti-corrosion protective coatings** applications



2022

Jan

Launched two epoxy-based **graphene-enhanced primers**, Genable Epoxy Primer, and HC primer



Feb

**Stanvac-Superon** started using AGM's graphene dispersions in **coatings for cable joints in industrial power transmission**



# Archer Materials Limited (formerly Archer Exploration)



2021

Mar

Further development of a **biochip** (using graphene-based materials as integrated circuits), reducing the size to **nanoscale**, potentially allowing droplets of **biological specimens to be analyzed and processed using graphene-based sensors**



Oct

Transitioned from a focused minerals exploration company to a **diverse materials technology company**



Raised \$15 M using a share purchase plan after a 12% higher intraday achieved by its shares



2022

Jan

Shares rose by 29% intraday after successfully **integrating a single-atom-thick sheet of graphene into a silicon wafer** using an electron beam lithography system



Feb

Received a **EU patent** for its 12CQ quantum computing chip technology. Now, it has protection in 16 countries around the world



Technical validation of **quantum information** on their 12CQ carbon-based qubit quantum computing chip at room temperature showed its usage potential in mobile technology





..

2021-2023

Their PE-CVD graphene flakes were used in a 2021 [research paper](#) for the application of [low-defect graphene and graphene oxide on the pH-responsive release of phenformin](#)



Tests with graphene combined with other materials have been done in collaboration with [Future Materials](#). This catapult center helps Cealtech to develop and promote new graphene-based materials



Received \$729,837.90 funding for the development, optimization, and scale-up of a [silicon-graphene nanoengineered anode](#) for Li-ion battery







2021

Feb

Raised \$1M in a placement to **expand exploration** in Australia and Mexico and to use for **working capital purposes**



Mar

Enhanced portfolio of base/precious metal projects by **acquiring the high-grade Santa Teresa Gold Project in Mexico and the Barraba Copper Project in Australia**



Oct

Agreement with **International Graphite Ltd.** to form a **vertically integrated high-technology graphite business**. Upon an \$8M transaction in shares with a public offering and listing on the ASX



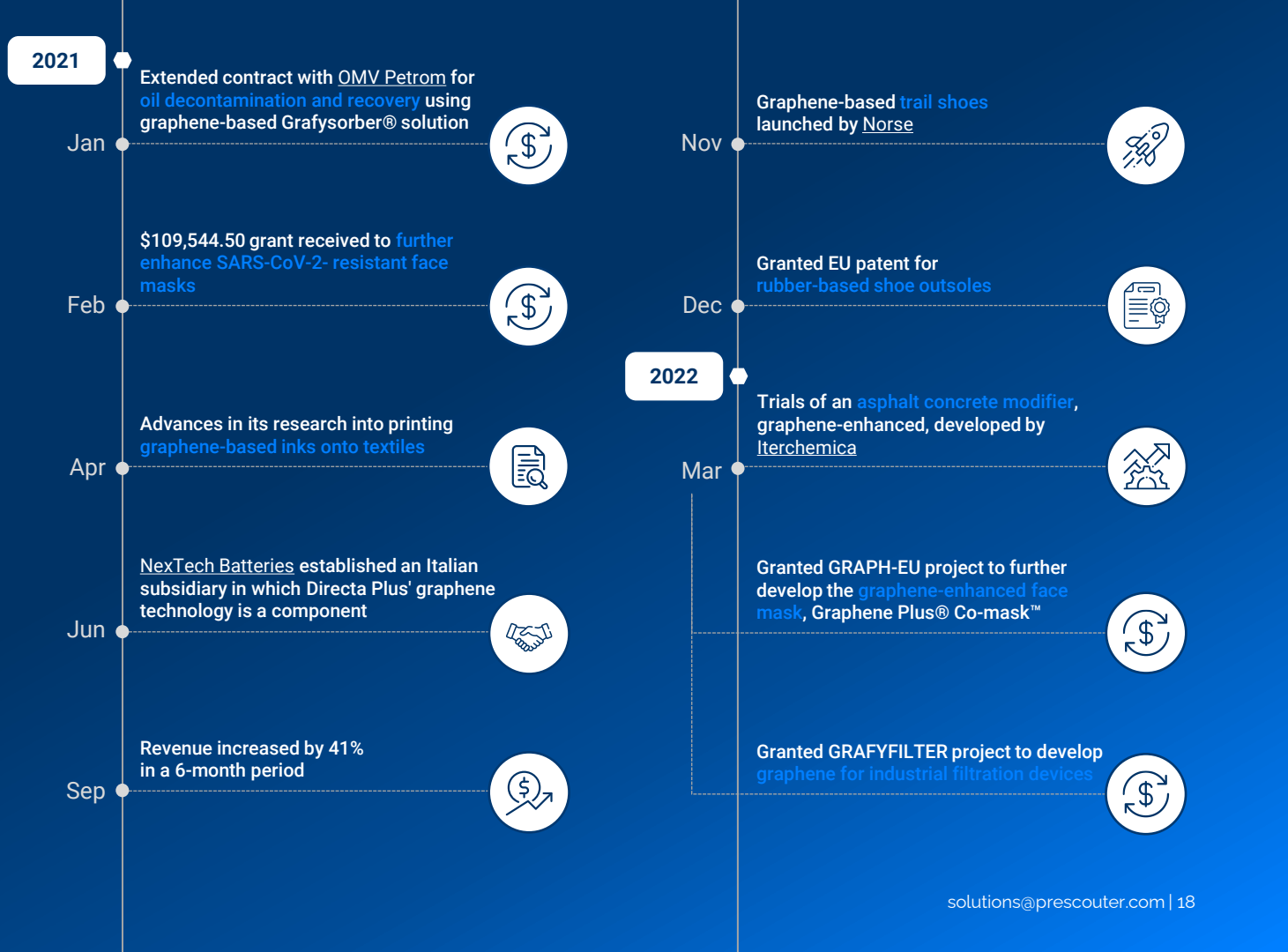
Adopted an **Environmental, Social, and Governance (ESG)** framework to ensure that their mineral exploration activities are taken in a manner that addresses the investors' and society's expectations and concerns



Nov

Graphite micronization final results from test work showed a **50% increase in yield compared to previous tests**. This processed graphite is a precursor material for lithium-ion battery anode production





# Elcora Advanced Materials

**Elcora**  
Advanced Materials

2021

Oct

Engaged with Lab 4 Inc. to develop and scale up a **new graphite production site** in Tanzania



Nov-Dec

Acquired STE Ermazone A.R.L, a company owing 10 **vanadium sites** in Morocco



2022

Announced plans on extracting and processing battery-grade minerals and metals from current projects and applying the materials to proprietary energy storage applications, aiming to **become a vertically integrated battery material company**



# First Graphene



2021

Jan

Application of graphene platelets as an enabler for low carbon concrete in a [research paper](#) showing the best performance with 56 microns size



Mar

Positive results in researching new [graphene catalysts](#) for low-cost hydrogen fuel cells



Released a new product line, PureGRAPH® AQUA, a range of [water dispersed graphene additives](#)



Collaboration with [Gerdau](#) to grow the graphene industry in the Americas



Apr

Product line extension with a new [50-micron platelet size](#) designed for concrete strengthening and polymer reinforcement



Jun

Distribution agreement signed with [GtM Action Ltd](#) to provide representation into the New Zealand concrete market



Agreement with [Advanced Material Development](#) to collaborate in AMD's portfolio of conductive inks



Launched new product line: a graphene-loaded low-density polyethylene (LDPE) [masterbatch](#) for easier dispersion into thermoplastics



New graphene-enhanced products



Graphene-enhanced [safety boots](#) launched by [Steel Blue Boots](#)

Graphene-enhanced surfboard line launched by [Katana Surf](#)

Glass-reinforced plastic boat launched by [Ascent Shipwrights](#)

Polyurethane [wear liner material](#) launched by [newGen Group](#)

# First Graphene



2021

Jul

Released a [whitepaper](#) on patented hydrodynamic cavitation process to transform petroleum into graphite and graphene



Aug

[Swimming pools](#) manufactured with graphene-infused resin launched by [Aquatic Leisure Technologies](#)



Oct

Review of its go-to-market strategy and adoption of a 'market-maker' approach, driving demand for graphene



Nov

Product line expansion with new [MB-EVA Bitumen masterbatch](#) for blending into asphalt mixture



Dec

UK patent filed on graphene-enhanced cement admixtures to scale up the production



2022

Jan

Collaboration agreement signed with [Fosroc](#) for the development of grinding aids as cement additives



Feb

UK patent granted for [coating battery anode](#) particles with graphene



Collaboration agreement signed with [Mayur Resources](#) for the development of low-carbon cement products to reduce carbon dioxide emissions



Mar

10-year partnership agreement signed with [NeoGraf Solutions](#) for the development and growth of the graphene market in the U.S.



# G6 Materials



2021

Mar

Announced plans to acquire GX Technologies, LLC in a \$7.5 M CAD deal



Apr

Successfully closed a \$5.4 M private offering for funding the acquisition of GX and expanding a pilot facility



May

Granted patents related to a method of graphene enrichment and a water-soluble 3D printing material



Aug

Completed transaction to acquire GX Technologies, LLC



Sep

Positive results on antimicrobial efficacy tests for a graphene-based air purifier prototype



Nov

New pilot-scale graphene oxide reactor providing a 5-fold production capacity increase



Dec

New location in California, to be used as an office and warehouse facility



2022

Jan

Graphene Laboratories, Inc., its subsidiary, received the ISO 9001 certification for a manufacturing facility in NY, which was also a prerequisite to an exclusive 5-year supply agreement with a EU-based global micro connector company



Feb

Graphene Laboratories, Inc. entered into a testing services agreement with the U.S. Army to research graphene oxide adsorption capabilities for the removal of complex contaminants





2021

Mar

Terminated merging plans with [Stria Lithium](#) due to *"matters beyond the reasonable control"*

In 2018, companies co-developed a graphene-based filtration membrane to separate magnesium and calcium from salars



Jul

Acquired part of [Braille Energy Systems Inc.](#) for investment purposes



2021

Feb

Started a collaborative project to develop the [terahertz spectroscopy technique](#), a novel measurement tool for graphene characterization that can penetrate graphene films



Oct

Obtained ISO 13485 certification for manufacturing medical device components, in particular [non-implantable biosensors](#)



Nov

Joined the [European Photonics Industry Consortium](#) to [increase presence in the photonics industry](#)



2022

Feb

Developed a [manufacturing process](#) to create transistor structures on graphene, enabling the [fabrication of pixelated structures for photodetector arrays](#) and [electro-optical modulation in waveguides](#), for example



Nov

Launched Cartridge S2X, a product for easy fabrication of graphene-based sensors especially designed for [biosensing](#)







2021

GraphenSic's epitaxial graphene samples were used in a 2021 [research paper](#) for the application of [graphene-based aqueous systems for enhanced and selective ion separations](#) showing great potential





2021

Aug

Filed a joint patent with Airbus on **graphene composites with improved lightning strike** performance alleviating the need for copper mesh



Dec

Agreement of graphene nano-platelets exclusive supply for being incorporated into iCraft's **PPE face masks**



2022

Jan

Launch of a nylon jacket made with **graphene-coated fabric, THERMiT™**, with increased thermal insulation rate



Feb

Awarded £135,000 contract collaboration with Cadent Gas to develop **graphene ink-based heaters for low power hot water**



Mar

Awarded £168,573 funding to develop **high-barrier monolayer films for food packaging** using functionalized nanomaterials, HiBarFilm2 Project by Innovate UK



2021

Apr

Received regulatory approval to produce and sell GrapheneBlack™ in Canada for uses as an additive in plastics, thermosetting composites, paints and coatings, and as a component of battery electrodes



Jun

Agreement with Gerdau Graphene, application developer, to supply and distribute graphene in the Americas region



Agreement with Techmer PM, LLC to supply GrapheneBlack™ grade of products



Aug

Awarded a multi-year contract to supply graphene for fuel and brake lines for passenger vehicles produced by Martinrea



2022

Feb

Announced a \$30 M public offering intended for general corporate purposes which may include pursuing potential acquisitions and fund its growth strategies



Experts at Paradigm Capital, investment dealer, positively analyzed NanoXplore after the Q2 2022 financial results release and claimed to expect the production to achieve 12,000 tons/year by the end of 2023



Mar

Announced the commissioning of VoltaXplore's demonstration facility, a Joint Venture between NanoXplore and Martinrea





2021

Sep

Started a graphite mining campaign in Sweden, extracting a 2,500-ton sample, to be processed into lithium-ion battery anode products



2022

Feb

Successfully produced lithium-ion battery anode product, Talnode®-C, during commissioning of new electric vehicle anode plant in Sweden. Product will be shipped to battery cell makers to undergo large-scale commercial trials in electric vehicle batteries





2021

May

Joined the Graphene Engineering Innovation Centre (GEIC) as a partner in a flexible support model



Jun

Teamed up with Johnson Matthey and the Graphene Application Center at CPI to optimize battery technology using graphene and carbon nanotubes



Jul

Announced a new joining venture with Mason Graphite to launch Black Swan Graphene for bulk graphene production



Sep

Announced the first commercial use of graphene-enhanced concrete patented by Black Swan Graphene



Dec

Black Swan Graphene planned to trade at the TSX and raised \$5 M CAD



2021

Feb

Graphene-enhanced **face masks** met the FFP3 European protection standard, demonstrating <2% inward leakage and filtering at least 99% of particulate matter



Apr

Entered into agreements with Graphene Lab, specialized in chemical vapor deposition graphene



May

First-time use of Concretene, a concrete containing graphene-based additive, in a commercial setting



Aug

Scheduled proof of concept trials to test **3D printing** of graphene-reinforced **concrete** using 'Printrastructure' technology in a new high-speed rail network, by SCS JV



Sep

University of Gloucestershire carried out trials on Versarien's graphene-coated **sportswear**



Provided graphene, through Concretene, to the Graphene Engineering Innovation Centre (GEIC) for building a '**living lab**' to test performance in exterior conditions



Nov

Partnership to produce graphene-enhanced **garments** with DKH Retail Limited to improve thermal and moisture management properties



2022

Feb

Pre-launch of graphene-enhanced **shoes** by Flux Footwear LLC to improve the rubber outsole



Mar

Launched 'Lunar' lifestyle pods, rooms that could be used as office/studio/gym, building printed with Cementene™





2020

May

Announced the use of graphene nanoplatelets in hockey sticks made by Grays Hockey with energy being more efficiently transferred and more shock absorbed



2021

Sep

Provided graphene to graphene-enhanced polyurethane foam development for lowering noise and weight in vehicles, produced by Ford Motor



# Zentek (formerly Zen Graphene Solutions)

**zentek**

2021

Jan

Agreement with Trebor Rx for the application of a graphene-based coating on nitrile gloves



Feb

Recognized as a Venture 50 company by the [TSX Venture Exchange](#) for 2020, based on market capitalization growth, share price appreciation, and trading volume



Mar

Agreement to accelerate the development of a large graphite deposit in Albany, Canada



Jun

Filed patent for graphene-based [diesel fuel additive](#) technology



Sep

Commercial agreement with [Trebor Rx](#) for the manufacturing of graphene-enhanced [personal protective equipment](#)



Nov

Awarded the [Innovation Solutions Canada Testing Stream](#) contract to test ZENGuard™-coated HVAC filters



Issued a Medical Device Establishment License by [Health Canada](#), for the manufacture and distribution of class one medical devices, such as graphene-enhanced PPE



Developed a [nanotechnology-enhanced coating with dispersed graphene](#), designed to prevent ice accretion for aircraft, wind turbines, ocean vessels, and building structures applications





# Zentek (formerly Zen Graphene Solutions)

**zentek**

2022

Jan

Successfully closed a C\$33 M offering for capital expenses, research and development, acceleration of business growth opportunities and working capital



Cooperated with GMAF Circular Medico to incorporate ZENGuard™ into surgical masks recycling program and convert them into polypropylene pellets



Feb

Filed a provisional patent on graphene-wrapped silicon anode material to improve lithium-ion battery technologies



Mar

Partnered with Vimta Labs to study ZenGUARD™ active ingredient as a potential treatment of infectious skin disease



Filed patent on ZenGUARD™ technology, graphene silver nanocomposites for coating as an antimicrobial agent



2021

Feb

Application of graphene oxide in nanofiltration membranes to functionalize poly(benzimidazole) in a research paper



Mar

Application of graphene oxide in silver nanoparticles as an antiviral agent against influenza A and OC43 coronavirus infection in vitro in a research paper



Synthomer Plc invested in William Blythe's battery testing facilities giving them the ability to test electrochemical properties of graphene-based materials



Apr

Application of graphene oxide in cancer cells in vitro with positive results when compared to normal cells in a research paper



Jul

Application of graphene oxide in a nano-silver matrix for dentistry root canal treatment showing graphene oxide potential as an irrigation agent in a research paper



Sep

Graphene oxide products were assigned with a CAS number during the REACH registration process



2022

Feb

Application of graphene oxide, carbon nanotubes, and silver nanoparticles as reinforcement fillers of a polyetheretherketone (PEEK) matrix in a research paper showing potential as semiconductors for aerospace and automobile applications



Mar

Announced exhibition in June of 2022 at the Advanced Materials Show. It planned on bringing news on the development and scale-up of its advanced materials portfolio



LayerOne  
(formerly  
Abalonyx)



2020

Jan

Abalonyx rebranded as LayerOne after  
Aker acquisition (in 2021)



Acquired by Clara Venture Labs, venture  
platform, aiming to focus on industrial  
scaling and building R&D



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# Additional Players

Newly profiled companies

# BoomaTech Graphene Technology



**Website:** <https://boomatech.com.br/>

**Contact:** Contact form

**HQ:** Brazil

**Company size:** 2-10 employees

**Founded:** 2013

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Boomatech is a Brazilian graphene startup producer and supplier. Its focus is on graphene in its wide range of forms (film, powder, flakes, water, and solvent-based solutions) and graphene oxide. It also offers R&D services (know-how) and graphene-based lithium-ion batteries.



Product type



Powder, flakes, and solutions



Production  
methods



Chemical electro-exfoliation



Production  
capacity



3.6 - 6 tons/year (2022)



Applications



Cementitious materials, conductive glasses, inks and coatings, electronics, automotive, agriculture, biomedical, and energy storage industries



# Boomatech

## Investors Overview

The company was officially launched in 2019, after almost 10 years of investments in research and development. Boomatech is a spin-off from Master Power Turbo, a Brazilian manufacturer of turbochargers, founded in 1966.

## Recent Developments

May 2021

### Featured and runner-up in a startup challenge

The challenge “Sebrae Like a Boss” happened during the Gramado Summit 2021 event and had 24 startup representatives pitching their innovative solutions and business operations ideas.

Nov 2021

### Participation at the Graphene Brazil Tech event

Isabella Borghetti's talk, “The Startups’ role on the graphene market development in Brazil”, emphasized how startups connect new technologies to the industry.

### Award as Innovative Project

“Gigia Bandera” is awarded annually to small companies investing in innovation.

Dec 2021

### One of the 15 startups to watch in 2022

Ranked as a promising startup, according to Sebrae RS

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6. <https://digital.sebraers.com.br/blog/15-startups-gauchas-para-ficar-de-olho-em-2022/>

# Product Overview

## GRAPHENE PRODUCTS

Product	Type	Applications
Reduced Graphene Oxide	Powder	Polymers, injection processes, rotational molding, etc.
Reduced Graphene Oxide in Formic Acid	Solution	Polymers, polyamides, reinforcement, etc.
Graphene Oxide in PGMEA	Solution	Waxes, varnish, and coating
Reduced Graphene Oxide in Butyl Acetate	Solution	Waxes, special paints, and coating
Graphene Oxide Water	Solution	Inks, ultra-resistant gels, biosensors, metal coatings, and polymeric resins
Graphene Oxide	Flakes	Inks, anticorrosion coatings, and thermal protectors
	Film	Membranes, aerogels, and conductive or resistive films

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## Case Study

Manufactured a **graphene-based compressor** housing in partnership with Master Power Turbo. The graphene composite, blended with polymers, replaced a metallic alloy



1- [https://www.instagram.com/p/OU5xUT\\_BNK/](https://www.instagram.com/p/OU5xUT_BNK/)

# The Sixth Element Materials Technology Co. Ltd.



The Sixth Element Inc.



**Website:** <https://www.c6th.com/>

**Contact:** Contact form

**HQ:** Changzhou, China

**Company size:** 51-200 employees

**Founded:** 2011

**Estimated revenue:** \$15.91M

1. <https://www.linkedin.com/company/the-sixth-element-changzhou-materials-technology/about/>
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3. <https://www.c6th.com/>

The Sixth Element Inc. is a Chinese graphene and graphene oxide manufacturer, R&D, and nanotechnology research company. Since 2014, it is part of the Chinese National SME share transfer system and has REACH registration. The company is ISO 9001 certified since 2014, ISO 14001 since 2018, and IAF 16949 since 2019. It counts on Wuxi Graphene Film as its subsidiary.



Product type



Powder, suspensions, and films



Production  
methods



Exfoliation and CVD



Production  
capacity



1,000 tons/year



Applications



Batteries, energy storage, electronics, reinforced plastics, anti-corrosion coatings, and adhesives for automotive and marine



The Sixth Element Inc.

# The Sixth Element Inc.

## Investors Overview

**Mar 8, 2019**

### **It holds 30% of Wuxi Graphene Film (Mar 8, 2019)**

Grahope New Materials acquired 70% and The Sixth Element Inc. 30% of Wuxi Graphene Film. The latter has a production capacity of 5M films per year. Thenceforth, The Sixth Element Inc. has focused mainly on graphene flake production.

**Sep 9, 2021**

### **Expansion of production capacity in Nantong**

It has been investing €60Mat a new site in Nantong in two parts: the first part was finalized in May 2020, expanding the production capacity to 650 tons/year being 500 of graphene oxide and 150 of reduced graphene. It plans on concluding the second part of the investment in mid-2022 to establish a total capacity of 1950 tons/year in Nantong.

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5. <https://www.c6th.com/news/the-industrialization-of-graphene-in-china-39086410.html>
6. <https://www.c6th.com/news/for-european-customers-the-sixth-element-pro-53958008.html>

## Recent Developments

**Apr 26, 2019**

### **Graphene products provided for smartphone development**

It supplied graphene cooling films to Huawei Mate 20 X and P30 Pro new smartphones. In 2020, a new smartphone model was launched, the Huawei P40 Pro Plus, which is believed to have the same graphene film cooling technology for heat management from The Sixth Element Inc.

**Oct 23, 2020**

### **Enhanced production capacity**

It announced that a new plant in Nantong, China has the capacity to produce 500 tons/year of graphene oxide and 150 tons/year of graphene. This expansion takes the company's total production capacity to 1000 tons/year.

**Feb 10, 2022**



### **Graphene products in Europe**

It started supplying graphene products from stock in Europe by a collaboration with a European logistics provider.

# Product Overview

The company provides graphene, graphite powder, and suspensions (water and solvent-based graphene suspensions)

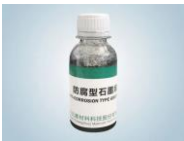
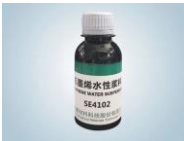
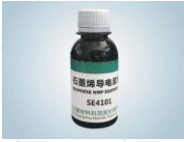
## GRAPHENE PRODUCTS

Product	Description	Main characteristics	Applications
SE1231   SE1232   SE1233   	Electrical and thermal conduction type graphene	<ul style="list-style-type: none"><li>• Black powder   pH 6-8   Tap density: <math>&lt;0.1\text{g/cm}^3</math></li><li>• Surface area: 180-280   260-350   400-600<math>\text{m}^2/\text{g}</math></li><li>• Particle size <math>D_{50}</math>: <math>&lt;10</math>   <math>&lt;10</math>   <math>&lt;50\text{ }\mu\text{m}</math></li><li>• C (wt%): <math>\geq 97\%</math>   <math>\text{H}_2\text{O}</math> (wt%): <math>&lt;1.0</math></li></ul>	Coatings, printing inks, polymers, batteries, thermal conductive gels, and LED
SE1430   	Enhancement type graphene	<ul style="list-style-type: none"><li>• Black powder   pH 2-5   Tap density: <math>&lt;0.1\text{g/cm}^3</math></li><li>• Surface area: 180-280 <math>\text{m}^2/\text{g}</math></li><li>• Particle size <math>D_{50}</math>: <math>&lt;10\text{ }\mu\text{m}</math></li><li>• C (wt%): <math>75\pm 5\%</math>   <math>\text{H}_2\text{O}</math> (wt%): <math>&lt;4.0</math></li><li>• S (wt%): <math>&lt;0.5</math>   O (wt%): <math>16\pm 3\%</math></li></ul>	As reinforcement of polymer and carbon fiber composites

<sup>1</sup> - <https://www.c6th.com/graphene/>

# Product Overview


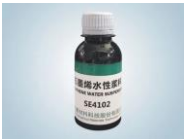
## GRAPHENE PRODUCTS

Product	Description	Main characteristics	Applications
SE1132   SE1133   	Anti-corrosion type graphene	<ul style="list-style-type: none"> <li>• Black powder   pH 6-8   Tap density: <math>&lt;0.1\text{g/cm}^3</math></li> <li>• Surface area (<math>\text{m}^2/\text{g}</math>): 180-280   260-350</li> <li>• Particle size D50: <math>&lt;10\text{ }\mu\text{m}</math></li> <li>• C (wt%): <math>\geq 93</math>   <math>\text{H}_2\text{O}</math> (wt%): <math>&lt;1.0</math></li> <li>• S (wt%): <math>\geq 0.2</math>   O (wt%): <math>\geq 3</math></li> <li>• Oil absorption (<math>\text{mL}/100\text{g}</math>): <math>500\pm 100</math>   <math>600\pm 100</math></li> </ul>	All types of (heavy duty) anti-corrosive coatings
SE4102-1   SE4102-2   	Graphene water suspension	<ul style="list-style-type: none"> <li>• Black solution</li> <li>• pH 6-9</li> <li>• Particle size D50: <math>\leq 2\text{ }\mu\text{m}</math>   <math>D_{90}</math>: <math>\leq 4\text{ }\mu\text{m}</math></li> <li>• Solid content (%): <math>14\pm 1</math>   <math>\text{H}_2\text{O}</math> (wt%): <math>&lt;1.0</math></li> <li>• Cosolvent (%): <math>25\pm 1</math>   0</li> </ul>	Water-based coating fields
SE4102-1   SE4102-2   	Graphene NMP suspension	<ul style="list-style-type: none"> <li>• Black solution   pH 6-9   <math>\text{H}_2\text{O}</math> (ppm): <math>\leq 1000</math></li> <li>• Particle size <math>D_{10}</math>: <math>\geq 2\text{ }\mu\text{m}</math>   <math>D_{50}</math>: <math>7-20\text{ }\mu\text{m}</math>   <math>D_{90}</math>: -</li> <li>• Impurity metal content (ppm): <math>&lt;5.0</math></li> <li>• Fraction of iron ions (ppm): <math>&lt;20</math></li> <li>• Total solid content (%): <math>5.2\pm 0.2</math>   SC: <math>4.2\pm 0.2\%</math></li> <li>• Viscosity (<math>\text{m pa.s}</math>): <math>\leq 3500\text{ }10\text{S}^{-1}</math>   <math>\leq 1500\text{ }100\text{S}^{-1}</math></li> </ul>	In conductive agent of lithium batteries, anti- static coatings, and other fields

1- <https://www.c6th.com/graphene/>

# Product Overview

## GRAPHITE PRODUCTS

Product	Description	Main characteristics	Applications
SE2430W-N 	Graphite Oxide	<ul style="list-style-type: none"><li>• Black paste</li><li>• pH 1.8-2.3</li><li>• Solid content (%): <math>43 \pm 5</math></li><li>• C (wt%): <math>51 \pm 5</math></li><li>• S (wt%): <math>\leq 2.0</math></li></ul>	Polymer composites, anode and cathode materials of Li-ion batteries, graphene thermal conductive film, and catalyst loading
SE3122   SE3522   	Graphite Oxide Suspension	<ul style="list-style-type: none"><li>• Black suspension</li><li>• pH 1.5-2.5   1.5-2.5</li><li>• Solid content (%): <math>1 \pm 0.2</math></li><li>• Particle size <math>D_{50}</math>: <math>8 \pm 4 \mu\text{m}</math>   <math>&lt; 4</math></li><li>• Packaging: 1L, 3L, 20L, 200L sealed barrel</li></ul>	Polymer composites, anode and cathode materials of Li-ion batteries, graphene thermal conductive film, and catalyst loading

<sup>1</sup> - <https://www.c6th.com/graphene/>



# Global Graphene Group Inc. (formerly Angstrom Materials)



**Website:** Link

**Contact:** +1 (937) 331-9884

**HQ:** Ohio, US

**Company size:** 51-200 employees

**Founded:** 2007

1. <https://www.graphene-info.com/angstrom-materials>
2. <https://www.linkedin.com/company/angstrom-materials/about/>
3. <https://www.zoominfo.com/c/angstrom-materials-inc/353644156>
4. <https://www.theglobalgraphenegroup.com/technical-services/>
5. <https://www.theglobalgraphenegroup.com/quality/>
6. <https://patents.justia.com/assignee/global-graphene-group-inc>
7. <https://www.theglobalgraphenegroup.com/technologies/>

Global Graphene Group (G3) is a graphene, graphene-products, and first advanced materials manufacturer. It is ISO 9001 certified since 2015, its products have TSCA and REACH certification, and it is a holding company for various subsidiaries, such as Taiwan Graphene Company (single-layer graphene producer), Honeycomb Battery and Angstrom Energy Company (both lithium-ion battery electrodes producers), and Nanotek Instruments (IP-holding). Angstrom Materials Group was assigned as a R&D company on graphene-reinforced products.



Product type

Powder, dispersions (resins, solvents, and masterbatches), films, and graphene-enhanced batteries



Production methods

Exfoliation and CVD



Production capacity

300 tons/year



Applications

Automotive, energy and electronics, paints and coating, biomaterials, aerospace, sensors, etc.



# Global Graphene Group

## Investors & Partnerships Overview

2016-2018

### **Raised a total of \$13M in funding over 2 rounds**

Raised \$10M in June 2016 and \$3M in April 2018

Nov 2019

### **Joint Development Agreement (Nov 2019)**

Signed a JDA with a so-called “major Taiwan-based manufacturer” to incorporate graphene-enhanced materials into polyetheretherketone (PEEK)-based products. This initiative aimed to cover different portions of Asia within the semiconductor industry

Dec 2019

### **Letter of Intention with Alison Asia Pacific (Dec 2019)**

Signed a 5-year LOI to provide over 300 metric tons of graphene-enhanced silicon oxide anode material to Alison Asia Pacific based in Hong Kong, which drove G<sup>3</sup> expansion production

1. <https://www.crunchbase.com/organization/global-graphene-group>
2. <https://www.thegraphenecouncil.org/blogpost/1501180/335313/Global-Graphene-Group-Taiwan-Company-Sign-JDA>
3. <https://www.graphene-info.com/global-graphene-group-signs-loi-alison-asia-pacific-fro-graphene-enhanced>
4. <https://www.thegraphenecouncil.org/blogpost/1501180/356914/Global-Graphene-Group-Awarded-Patent-on-Elastic-Anode-Battery-Materials>
5. <https://twitter.com/AMIGraphene/status/1352614968315830273?xt=HHwWgcC7hbaJusUIAAAA>
6. <https://www.theglobalgraphenegroup.com/global-graphene-group-recognized-by-lexisnexis-as-a-global-top-100-innovator/>

## Recent Developments

Oct 2020

### **Lithium batteries materials patented in the U.S.**

Awarded a US patent on elastomer-encapsulated particles of high-capacity anode active materials for lithium batteries. Afterward, it will expand its silicon-based anode materials production. As of 2022, its patent portfolio includes +600 patent applications and issued patents

Jan 2021

### **Presentation during the Virtual Silicon Symposium**

CEO, Dr. Bor Jang, talked about the gaps in today's Li-ion batteries and how its battery tech addresses driving range, safety, recharging, and life issues

Jan 2022

### **Global Top 100 Innovator recognition by LexisNexis®**

One of the 12 companies recognized in the Chemicals and Materials industry sector by the “Innovation Momentum 2022: The Global Top 100”. This report, produced by LexisNexis, is an intellectual property report that recognizes global technology companies with exceptional technological relevance for the future

## GRAPHENE PRODUCTS

### Product



N002-PDRAM | N002-PDEAM

### Description

Fluffy powder

### Main characteristics

- Average lateral dimension: 2-4  $\mu\text{m}$
- Thickness: 1-2 nm
- Tap density: 0.01-0.02g/cm<sup>3</sup>
- Surface area (m<sup>2</sup>/g): 400-800
- C (wt%):  $\geq 95$  | H (wt%):  $\leq 2$  | N (wt%):  $\leq 0.05$
- O (%):  $< 2.5$  | 10-30

N002-PDRAM | N002-PDEAM

Powder

- Average Lateral dimension: 7  $\mu\text{m}$
- Thickness: 30-50 nm | 70-100 nm | 30-50 nm
- Tap density (g/cm<sup>3</sup>): 0.1-0.2 | 0.1-0.3 | 0.05-0.15
- Surface area (m<sup>2</sup>/g): 20-30 | 10-15 | 20-30
- C (wt%):  $\geq 95$  |  $\geq 97$  |  $\geq 96$  | O (%):  $\leq 4$  |  $\leq 2$  |  $\leq 1$
- H (wt%):  $\leq 1$  | N (wt%):  $\leq 0.2$  |  $\leq 0.5$  |  $\leq 0.2$

N008-P-40

Powder

- Average Lateral dimension: 10  $\mu\text{m}$
- Thickness: 50-100 nm
- Tap density (g/cm<sup>3</sup>): 0.05-0.15
- Surface area (m<sup>2</sup>/g): 10-30
- C (wt%):  $\geq 97$  | O (%):  $\leq 1$
- H (wt%):  $\leq 1$  | N (wt%):  $\leq 0.2$

1. <https://www.theglobalgraphenegroup.com/wp-content/uploads/2019/10/Powders-and-Intermediates-04152019.pdf>  
 2. <https://www.taiwantrade.com/product/n002-pde-single-layer-nano-graphene-oxide-platelet-1731339.html#>

# Product Overview

Graphene dispersed in composite pastes

## GRAPHENE PRODUCTS

### Product

**Ge-TH-G000 | Ge-TH-G030**

**Ge-TH-G040 | Ge-TH-G042**

### Main characteristics

- Thermal conductivity (W/m·K): 2 | 5
- Specific gravity: 2.05 g/cm<sup>3</sup>
- Working temperature: 0-130 °C

- Thermal conductivity (W/m·K): > 6
- Specific gravity: 3.8 ± 0.2 g/cm<sup>3</sup>
- Working temperature: -40 - 150 °C

### Applications

Epoxy paste: ideal for electronic applications

Rubber paste: provides thermal management solutions

1. <https://www.theglobalgraphenegroup.com/graphene-nano-intermediates/>  
<https://www.theglobalgraphenegroup.com/wp-content/uploads/2019/10/Thermal-Management-Brochure-03192019.pdf>

# Product Overview

Graphene masterbatches included in graphene nano-intermediates materials

## GRAPHENE PRODUCTS

### Product

**GRAPHENE THERMOPLASTIC**

**EPOXY COMPOSITE MASTERBATCH**

### Details

Thermoplastic polymers: PE, HDPE, LDPE, LLDPE, PET, PA6, PA66, TPEs, and PVC

Patent protected dispersion technique to embed graphene into epoxy matrix for custom projects

### Applications

Sporting goods, clothing and textiles, ESD protection equipment, automobile, and packaging

Sporting goods, fiber-reinforcement, automobile and powder coating

1. <https://www.theglobalgraphenegroup.com/graphene-nano-intermediates/>  
<https://www.theglobalgraphenegroup.com/wp-content/uploads/2019/10/Thermal-Management-Brochure-03192019.pdf>
2. <https://www.theglobalgraphenegroup.com/wp-content/uploads/2019/10/Powders-and-Intermediates-04152019.pdf>

# Product Overview

Graphene dispersions also included in graphene nano-intermediates materials

## GRAPHENE PRODUCTS

Powder product	Graphene type	Possible solvents		Main characteristics
N002-PDRAM N002-PDEAM	Graphene	<ul style="list-style-type: none"> <li>1-Methyl-2-pyrrolidone (NMP)</li> <li>Diethylene Glycol</li> <li>Ethylene Glycol</li> <li>DMSO</li> <li>DMAC</li> </ul>	<ul style="list-style-type: none"> <li>THF</li> <li>MIBK &amp; MEK</li> <li>n-Butyl Acetate</li> <li>Benzyl Alcohol</li> <li>1-phenoxy-2-propanol</li> <li>Ethyl Benzene</li> </ul>	<ul style="list-style-type: none"> <li>Average lateral dimension: 5 <math>\mu\text{m}</math></li> <li>Thickness: 0.35 - 2 nm</li> <li>Concentration (wt%): 0.1   0.5 - 1.0   0.1 - 2.0</li> <li>Average aspect ratio (l : w): 3000 : 1</li> </ul>
EPOXY COMPOSITE MASTERBATCH	Graphene oxide	<ul style="list-style-type: none"> <li>Water</li> <li>DMAC</li> <li>Aniline</li> <li>Propylene Carbonate</li> </ul>		<ul style="list-style-type: none"> <li>Average lateral dimension: 5 <math>\mu\text{m}</math>   0.01 - 0.06 <math>\mu\text{m}</math></li> <li>Thickness: 0.35 - 2 nm   0.35 - 1 nm</li> <li>Concentration (wt%): 0.1   0.15   0.5, 1.0</li> <li>Average aspect ratio (l : w): 3000 : 1</li> </ul>

1. <https://www.theglobalgraphenegroup.com/graphene-nano-intermediates/>  
<https://www.theglobalgraphenegroup.com/wp-content/uploads/2019/10/Thermal-Management-Brochure-03192019.pdf>  
 2. <https://www.theglobalgraphenegroup.com/wp-content/uploads/2019/10/Powders-and-Intermediates-04152019.pdf>

# Product Overview



Graphene-enhanced coatings and paints

## GRAPHENE PRODUCTS


Product	Details	Applications
<b>THERMAL COATING &amp; PAINT</b>	Graphene-enabled heat-dissipating coatings / paints	Specifically designed for use with bulk heat sources
<b>CONDUCTIVE COATING &amp; INK</b>	Graphene-enabled liquid / anti-static liquids	Conductive printable inks, touch screens, and flexible displays
<b>ANTI-CORROSION PRIMER</b>	Modified graphene primer	Protects metal surfaces providing a barrier to oxygen, water, and acids
<b>ANTI-CORROSION MID-COATING</b>	Modified graphene mid-coating layer between primer and surface coatings	Anti-corrosive end products, such as paints

<sup>1</sup> - <https://www.theglobalgraphenegroup.com/paints-and-coatings/>

# Product Overview

Graphene thermal spreader films/sheets

## GRAPHENE PRODUCTS

Product	Description	Main characteristics	Applications
F	 Anti-corrosion type graphene	<ul style="list-style-type: none"> <li>Free standing sheets</li> <li>Flexible</li> <li>High thermal conductivity</li> </ul>	3C industry, large screen displays, LED lighting
AT1500-100	L	<ul style="list-style-type: none"> <li>Heat spreader layer</li> <li>Release coating layer</li> <li>PET film layer</li> </ul>	<ul style="list-style-type: none"> <li>PET backing on one side</li> </ul>
AT1500-90	LP	<ul style="list-style-type: none"> <li>Heat spreader layer</li> <li>One-sided adhesive</li> <li>PET film layer</li> </ul>	<ul style="list-style-type: none"> <li>PET backing on one side</li> <li>Weak bonding</li> </ul>
	LX	<ul style="list-style-type: none"> <li>PET layer</li> <li>One-sided adhesive layer</li> </ul>	<ul style="list-style-type: none"> <li>Insulating materials on both sides</li> </ul>

Thickness:  
AT1500-100 series  
100±15μm  
AT1500-90 series  
90±10μm

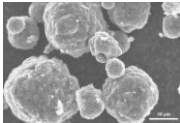


1. <https://www.theglobalgraphenegroup.com/wp-content/uploads/2019/10/Thermal-Management-Brochure-03192019.pdf>  
2. <https://www.theglobalgraphenegroup.com/thermal-management-heat-spreader/>



# Product Overview

Graphene-enhanced coatings and paints

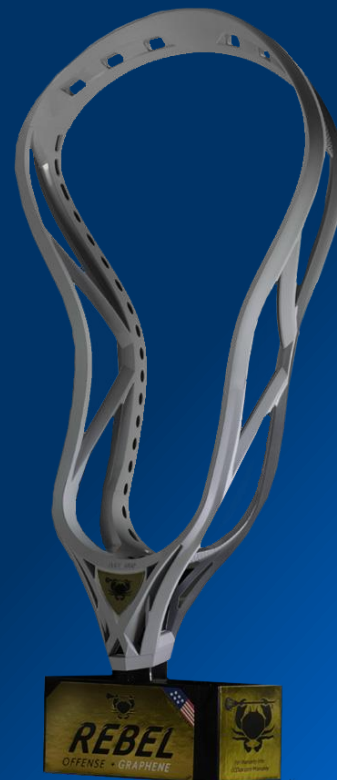
## GRAPHENE PRODUCTS

Product	Details	Applications
<b>GRAPHENE SULFUR COMPOSITE CATHODE</b>	 <ul style="list-style-type: none"><li>• Black powder   Particle Size <math>D_{50}</math>: 10 - 15 <math>\mu\text{m}</math> (tunable)</li><li>• Specific surface Area: 10 - 20 <math>\text{m}^2/\text{g}</math> (tunable)</li><li>• Packing density: 1.1 - 1.3 <math>\text{g}/\text{cm}^3</math>   Tap Density: 0.5 - 1.0 <math>\text{g}/\text{cm}^3</math></li><li>• Specific capacity: 850 - 950 <math>\text{mAh}/\text{g}</math>   First cycle efficiency: &gt; 95%</li></ul>	
<b>GRAPHENE ALUMINUM (GA-14) CURRENT COLLECTOR</b>	 <ul style="list-style-type: none"><li>• Graphene layer thickness: 30 - 50 <math>\mu\text{m}</math></li><li>• Width: 410 mm   Areal Density: 37 - 39 <math>\text{g}/\text{m}^2</math></li><li>• Electrical conductivity (in plane): <math>3.0 \times 10^5</math> - <math>3.1 \times 10^5</math> <math>\text{S}/\text{cm}</math></li><li>• Anti-oxidation (200°C - 30 minutes): No color change</li><li>• Storage at RT(&lt;50°C) with low humidity</li></ul>	Li-ion batteries, Li-metal batteries, Capacitors
<b>GRAPHENE COPPER (GC-08) CURRENT COLLECTOR</b>	 <ul style="list-style-type: none"><li>• Thickness: <math>8 \pm 1 \text{m}</math>   Graphene layer thickness 30 - 50 nm</li><li>• Tensile strength: &gt; 32 <math>\text{gf}/\text{mm}^2</math>   Elongation: &gt;3%</li><li>• Areal density: <math>71 \pm 1 \text{ g}/\text{m}^2</math>   Anti-oxidation: No Color Change</li><li>• Carbon content: &gt;90%   Electrical conductivity: <math>5.4 - 5.6 \times 10^3 \text{ S}/\text{m}</math></li></ul>	

<sup>1</sup> - <https://www.theglobalgraphenegroup.com/paints-and-coatings/>

## Case Study

Manufactured a limited edition of **Rebel + Graphene heads** graphene-based compressor housing in partnership with ECD Lacrosse. G<sup>3</sup> graphene composite increased impact strength, stiffness, and kept the light weight.



1. <https://www.graphene-info.com/ecl-lacrosse-and-global-graphene-group-g3-develop-graphene-enhanced-lacrosse-gear>
2. <https://lax-zone.com/collections/mens-lacrosse-heads/products/ecl-rebel-graphene-head-offense>

# Ningbo Morsh Technology Co. Ltd.



**Website:** <https://www.morsh.cn/>

**Contact:** [admin@morsh.cn](mailto:admin@morsh.cn)

**HQ:** Ningbo, China

**Company size:** 11-50 employees

**Founded:** 2012

**Estimated revenue:** \$5M

1. <https://www.marketsandmarkets.com/Market-Reports/graphene-market-83933068.html>
2. <https://worldwide.espacenet.com/patent/search/family/047051728/publication/CN102757038B?q=pn%3DCN102757038B>
3. <https://worldwide.espacenet.com/patent/search/family/056372684/publication/US10385189B2?q=pn%3DUS10385189B2>
4. <https://www.zoominfo.com/c/ningbo-graphite-technology-co-ltd/532120203>

Ningbo Morsh Tech. is a Chinese company focused on the production, sales, and R&D of graphene materials application technology. The company is one of Beijing Moxi Holding Group Co., Ltd. subsidiaries and is ISO 9001 certified. It is also a member of the [Nanjiang Group Company](#).



Product type



Powder, films, pastes, and coatings



Production methods



Exfoliation



Production capacity



500 tons/year



Applications



Cementitious materials, batteries, coating and paints, electronics

# Ningbo Morsh Technology

## Recent Developments

Nov 2018

### Announced environmental protection

Announced an environmental protection acceptance after the completion of a technical transformation in the production line of graphene-modified polymer plastic masterbatch.

Mar 2020

### Successful R&D cooperation

After supplying graphene slurry to Ningbo Fuli Battery Material Technology Co. Ltd. (NFB) for more than two years, IT announced that its R&D cooperation with NFB has achieved significant progress in lithium-rich manganese-based cathode materials

1. [http://www.morsh.cn/h-nd-187.html#\\_np=125\\_377](http://www.morsh.cn/h-nd-187.html#_np=125_377)
2. [http://www.morsh.cn/h-nd-210.html#\\_np=125\\_377](http://www.morsh.cn/h-nd-210.html#_np=125_377)
3. [http://www.morsh.cn/h-nd-208.html#\\_np=125\\_377](http://www.morsh.cn/h-nd-208.html#_np=125_377)
4. [http://www.morsh.cn/h-nd-215.html#\\_np=125\\_377](http://www.morsh.cn/h-nd-215.html#_np=125_377)

Feb 2020

### Provided graphene materials for medical purposes

Started to supply graphene composite powder materials to companies producing medical masks during the SARS-CoV-2 pandemics

Nov 2021

### Direction and Executive Board Inspection

The company's general manager and the R&D chief presented updates on the graphene conductive agent production line and the following work plan to the board of directors during a facility inspection

# Ningbo Morsh Technology

## Product Overview

Graphene-enhanced pastes

### GRAPHENE PRODUCTS

#### Product

**G-PASTE**



#### Main characteristics

- Gray/black paste
- Solid content (wt%): 4.0
- The average thickness of the lamella: 2.4 nm
- Slice size: 5-15  $\mu\text{m}$  | pH 6-7

#### Applications

Battery, starting capacitor, thermal/heat dissipating materials, water-based functional coatings, composite materials

**GC-PASTE4B**



- Gray/black slurry
- Graphene content (wt%): 4.0 $\pm$ 0.1
- Super P content (wt%): 4.0 $\pm$ 0.1
- Metal ions content (ppm): <30 | pH 6-7

Lithium, nickel MH, zinc manganese alkaline, advanced lead-acid batteries, and supercapacitor

**G-SLURRY4FC**



- Gray/black paste
- Solid content (wt%): 3 | pH 7-8
- Slurry viscosity: 200-1000 cps
- Coating conductivity (PET substrate): 100 S.cm<sup>-1</sup>

Ion batteries, supercapacitor

1. <http://www.morsh.cn/coll.jsp?id=132>  
2. [http://www.morsh.cn/h-pd-29.html#\\_pp=132\\_381](http://www.morsh.cn/h-pd-29.html#_pp=132_381)  
3. [http://www.morsh.cn/h-pd-27.html#\\_pp=132\\_381](http://www.morsh.cn/h-pd-27.html#_pp=132_381)  
4. [http://www.morsh.cn/h-pd-25.html#\\_pp=132\\_381](http://www.morsh.cn/h-pd-25.html#_pp=132_381)

Graphene-enhanced slurry and graphene powder and film

## GRAPHENE PRODUCTS

### Product

### Main characteristics

### Applications

**G-SLURRY4WC**



- Gray/black liquid
- Fixed amount (wt%):  $2.5 \pm 0.1$
- Viscosity: 200-1000 mPa.s
- Density:  $1.02-1.15 \text{ g/cm}^3$  | pH 7.5-9

Water-based: anti-corrosion, antistatic, architectural, and non-stick coatings

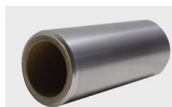
**GC-POWDER4B**



- Black powder
- Graphene content (wt%):  $47.5 \pm 0.2$
- SP content (wt%):  $47.5 \pm 0.2$
- Bulk density:  $0.15 \text{ g/cm}^3$
- Specific area:  $36 \text{ m}^2/\text{g}$  | Ash (wt%):  $<0.1$

Lithium, nickel MH, zinc manganese alkaline, advanced lead-acid batteries, and supercapacitor

**GC-FOIL**



- Gray/black coating
- Coating thickness on both sides:  $0.61 \mu\text{m}$
- Coating on both sides:  $0.04-0.1 \text{ mg/cm}^2$

Lithium-ion battery and supercapacitor

# Xiamen Knano Graphene Technology Co.



**Website:** <https://www.matsolint.com/>

**Contact:** [yxcheng@knano.com.cn](mailto:yxcheng@knano.com.cn)

**Founded:** 2010

**HQ:** Xiamen, China

**Company size:** 51-200 employees

**Estimated revenue:** about \$5M

1. <https://pitchbook.com/profiles/company/484066-90#overview>
2. <https://www.zoominfo.com/c/knano-company/430248623>
3. <https://www.matsolint.com/En/about.aspx?IntroCatelD=1661>
4. <https://worldwide.espacenet.com/patent/search/family/051140759/publication/CN103922323A?q=pp%3DCN103922323A>

Knano is a Chinese R&D and graphene manufacturer. The company has filed over 40 patents and is ISO 9001, ISO 14001, and ISO 45001 certified.



Product type

Powder, nanoplatelets powder, and pastes



Production methods

Exfoliation



Production capacity

200 tons/year



Applications

Cementitious materials, coatings, batteries, electronics



# Xiamen Knano Graphene Tech

## Investors Overview

### Since 2016

#### A NEEQ listed company

In 2016, it was listed under the stock code: 836410 at the National Equities Exchange and Quotations. NEEQ is the Chinese over-the-counter system for trading the shares of public limited companies.

## Recent Developments

Oct 2016

#### Six more patents were granted

Over 10 patents were applied, of which six were granted, all of them were graphene and graphene products-related

Mar 2020

#### Medical supplies during the pandemic

Provided medical supplies for front-line workers during the SARS-CoV-2 pandemics

May 2020

#### Company's 10th-anniversary celebration

Celebrated its 10th year anniversary and its graphene project was launched in 2006 and was set up in 2010

1. <https://www.matsolint.com/En/about.aspx?IntroCatelD=1661>
2. [https://www.matsolint.com/En/news\\_detail.aspx?NewsID=161](https://www.matsolint.com/En/news_detail.aspx?NewsID=161)
3. <https://www.matsolint.com/news/19.html>
4. [https://www.matsolint.com/En/news\\_detail.aspx?NewsID=226](https://www.matsolint.com/En/news_detail.aspx?NewsID=226)



# Xiamen Knano Graphene Tech

## Product Overview

Graphene powders and paste

Product	Main characteristics	Applications
KNG-G2	<ul style="list-style-type: none"> <li>Gray/black powder</li> <li>Moisture (%): &lt;2   Thickness: 1-3 layers</li> <li>Diameter(D<sub>50</sub>): 7-12 <math>\mu</math>m   Bulk density: 0.01-0.02 g/cc</li> </ul>	Polymers and coating
GC-PASTE4B	<ul style="list-style-type: none"> <li>Gray/black powder</li> <li>Fe content (wt%): 150 ppm max</li> <li>Thickness: 1-3 layers</li> </ul>	Batteries
G-SLURRY4FC	<ul style="list-style-type: none"> <li>Gray/black paste</li> <li>Total solids: 5.30<math>\pm</math>0.20%   Viscosity: <math>\leq</math>3000 mPa.s</li> <li>Conductive C content: 5.00<math>\pm</math>0.19%</li> <li>Moisture content: <math>\leq</math>1000 ppm</li> <li>Cu, Zn, Cr, Co, Ni content: <math>\leq</math>5 ppm   Fe <math>\leq</math>10 ppm</li> </ul>	Lithium-ion batteries

1. <https://www.matsolint.com/En/product.aspx?IntroCatelD=1803>  
 2. <https://www.matsolint.com/En/product.aspx?IntroCatelD=1915>  
 3. <https://www.matsolint.com/En/product.aspx?IntroCatelD=1852>

# Xiamen Knano Graphene Tech

## Product Overview

Graphene nanoplatelets

Product	Main characteristics	Applications
KNG-150	<ul style="list-style-type: none"> <li>Gray/black powder   Bulk density: 0.15-0.2 g/ml</li> <li>Specific surface area: 30-60 nm<sup>2</sup></li> <li>Powder conductivity: ~12000 S/m</li> <li>Thickness: &lt;15nm   C content (wt%): &gt;98</li> <li>Thermal conductivity: ~3000 W/mK</li> </ul>	Battery, starting capacitor, thermal/heat dissipating materials, water-based functional coatings, composite materials
KNG-180-3	<ul style="list-style-type: none"> <li>Gray/black powder</li> <li>Diameter (D50): 10-14 μm</li> <li>C content (wt%): &gt;98.0   Moisture: ≤1.5%</li> <li>Bulk density: 0.20-0.28 g/ml</li> </ul>	Thermal conductive silicone grease, electrothermal films, heat dissipation coatings
KNG-181-2	<ul style="list-style-type: none"> <li>Gray/black pellets</li> <li>Bulk density: 0.33-0.38 g/ml</li> <li>Moisture: 2% max</li> <li>Diameter (D50): 0.8-8 mm</li> </ul>	Thermal conductive polymers

<sup>1</sup> - <https://www.matsolint.com/En/product.aspx?IntroCatId=1667>

# Product Scientific Application

Its graphene products KNG-150 and KNG-G2 have been used in 2021 published research papers for:

nanoplatelets dispersion optimization and nano-filler loading in bio-based polymer nanocomposites based on tensile and thermogravimetry analysis

and

nanoplatelets application in composite films for electromagnetic shielding and flame retardancy evaluation, respectively.



<sup>1</sup> - [https://www.instagram.com/p/OU5xUT\\_BNK/](https://www.instagram.com/p/OU5xUT_BNK/)

# Supplier Interview

A deep dive into BoomaTech Graphene's technology

# Expert Interview



## **Isabella Borghetti**

Director, BoomaTech Graphene Technology

Isabella Borghetti is an industrial manager working in the automotive and nanotechnology industry. She has a bachelor's degree focused in international business specialized in negotiation and graphene market.

## Expert Interview

### Could you please tell me a bit more about your technology?

"BoomaTech's process and product technology were developed over 12 years of research and testing. Our graphene in different typologies have been tested and approved by several renowned universities around the globe, as well as private companies that have used them in different applications. The current process technology is via chemical electro exfoliation using controlled atmospheres, extracting a product of high purity, large surface area, and with 3 to 6 layers."

### You mention lithium-graphene batteries on the company's website. Is BoomaTech currently offering this product to the market?

"Our lithium-graphene batteries are in the prototyping stage. We have the technology being developed and some prototypes being tested in the laboratory. We've already got batteries that charge in up to 6 times less time, weigh up to 50% less, and yield 5 times more cycles. We are using graphene on both electrodes, positive and negative."

-- “ -----

*We've got batteries that charge in up to 6 times less time, weigh up to 50% less, and yield 5 times more cycles*

----- ” --

## Expert Interview

**Some companies offer their products based on the average thickness of the layers (in nanometers) and/or the size of the flakes/platelets (in microns). Do you also provide this information to your clients? How important is the thickness?**



"Yes, we do. All our products come with a datasheet, a technical report, with information regarding the characterization of that graphene batch."

*"Depending on the application, information on thickness and particle size is essential to ensure the existence of enough functionalized graphene crosslinks to the substrate, and no efficiency loss will occur to the expected results."*

## Expert Interview

**You mention nine different routes for making graphene. Are all these routes related to the **electrochemical exfoliation** method? Do you have other processes?**

"Yes, *route variations are basically different parameters within the same machinery and the same electrochemical exfoliation process.* So, what really changes are the parameters involved, for instance, time, temperature, amount of reagents, machinery arrangement, and raw material preparation."

"The final application demand dictates the substrate to incorporate and the properties to be improved, thus those process variations."





## Expert Interview

**Could you comment on the importance of raw material preparation and final characterization in graphene manufacturing? Can they vary depending on the chosen application?**



"Of course, as I mentioned in the previous answer, *the importance of raw material preparation is precisely due to quality control itself*. The supplied graphites have high metal levels and other pollutants (depending on the supplier), which can disrupt the graphene manufacturing process. By preparing all graphite received, we reassure the quality of the final graphene, regardless of the graphite purchased."

"As for the final characterization, we have two partner companies that characterize the materials. *The characterization results are included in the product report so that the customers can certify the graphene chemical information they are receiving*. In addition to private companies, several universities provide us characterizations services, such as Mackenzie, USP, Unisinos, Feevale, Poli SP, Unicamp, University of Manchester, and several Senai institutes throughout the country."

## Expert Interview

**Would you be willing to share any information related to past or current financing (such as investors, acquisitions, or plant expansions)?**



*"Our investment comes entirely from the group that originated the company, Master Power Turbo.*

We started by producing a few grams of graphene monthly, using a sensitive and laboring laboratory process. Then we increased production to 1 kg per month.

*Currently, we have a manufacturing capacity of 300 – 500 kg per month (depending on the typology).*

Our plant has already undergone three expansions."

“

*We intend to expand graphene production again to produce 12 t/a by the end of 2022*

”

## Expert Interview

### Do you have any case studies related to your graphene products application that you would like to share?

"The markets we currently operate in are the [energy market](#) (including batteries, conductive glass, supercapacitors, solar cells, etc.), [composites](#) (polymers, elastomers, etc.), paints and coatings (such as waxes, pre-treatment, baths, conductive paints, etc.), and [biosensors](#) (for disease detection, biological and electronic sensors). In addition to these major ones, we also have minor activities in additives for [concrete and construction](#), [textile industry](#) (special fabrics, fibers, and yarn), [agriculture](#) (fertilizers, containers, silos, etc.), [electronic circuits and sensors](#), and [paper and cellulose](#).

We cannot share our partners' names, but here are some examples:

- **Multinational tech company:** *[application of graphene oxide in biocompatible microchips and biosensors for disease detection](#)*
- **Energy company:** *[application of reduced graphene oxide in organic solar cells, increasing their efficiency to 43%, capturing visible + UV and IR spectra](#)*



# About the Authors



**Marija Jović**

Technical Director

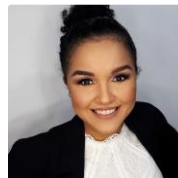
Marija is the Technical Director for PreScouter's Chemical, Materials, and Packaging verticals. She has worked across topics such as product and process improvement and development and sustainability throughout the chemicals, materials, and packaging industry. Marija completed her Master's degree in Chemical Engineering from Belgrade University and her Ph.D. in Organometallic Chemistry and Catalysis at the Swiss Federal Institute of Technology (ETH Zurich). Prior to her Ph.D., Marija worked in the chemical industry on the synthesis of new textile dyes.



**Beatriz Gonçalves**

Project Manager

Beatriz leads projects covering product and process improvement and development for the Chemicals, Materials, and Packaging industry. She is a Materials Engineer with 4+ years of hybrid experience, in both the materials area as well as corporate data analysis. She received her M.Sc. with distinction in Materials Science and Engineering from the Federal University of Sao Carlos, in Brazil. Before joining PreScouter, she gained professional experience in project management, data analysis, and product cost estimation, working in large-sized companies.



**Sanierlly Nascimento**

Researcher

Sanierlly holds a BSc and an MSc degree in Chemical Engineering. Her main study areas were food preservation and Excel VBA applied to thermodynamics problems. She is a specialist in Food Quality and Safety and has gained experience as a scholar here in PreScouter, working on Chemicals, Natural Resources, Materials, and Healthcare and Life Sciences projects. Currently, Sanierlly is pursuing her Ph.D. in Organic Chemistry focused on injectable hydrogels for drug delivery.



**Renjini G R**

Researcher

Renjini is a Scientist working in NoPo Nanotechnologies, an Indian company specializing in the field of Single Walled Carbon Nanotubes. She holds a BSc in Physics and an MSc in Nanoscience and Nanotechnology. Her expertise is in water purification and desalination using Thin Film Composite Membranes and is now working along with Indian Navy and other Government bodies to supply water filtration membranes and desalination membranes all over India.

# Potential Next Steps

- ✓ PreScouter can conduct anonymous interviews with companies profiled to help you learn more about their technologies
- ✓ processes, and partnership potential.
- ✓ PreScouter can identify the intellectual property position of these players and understand patent trend evolution.
- ✓ PreScouter can identify additional suppliers located in specific regions to source products and other services.



TECHNOLOGY  
LANDSCAPING



TRENDS  
MAPPING



TECHNOLOGY  
ROAD MAPPING



INTERVIEWING  
STARTUPS



IP  
LANDSCAPING



SUPPLIER  
OVERVIEWS



COMPETITIVE  
INTELLIGENCE



MARKET  
ANALYSIS



PARTNER  
OVERVIEWS

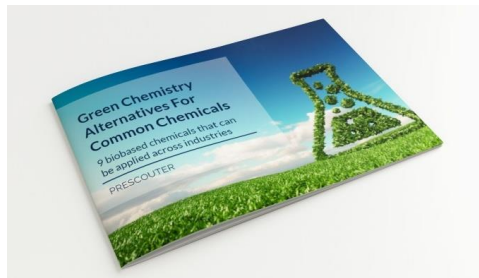


TECHNO-ECONOMIC  
ANALYSIS

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