Introduction to First Graphene

Graphene Council Webinar

Tuesday 8th June 2021

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Non-Executive Director & Senior Scientific Advisor
WHAT DO COMPOSITES, RUBBERS, ENERGY STORAGE AND CONCRETE ALL HAVE IN COMMON?
A growing number of established products and applications globally that are related to these markets, are being significantly enhanced by applying ‘graphene’ as a chemical additive.
What makes graphene compelling – current trends, facts and statistics:

- Rubbers and elastomers show major improvements in tensile strength, elongation, abrasion resistance and tear strength with the addition of graphene.

- Independent studies found graphene can make selected products up to 30% stronger and more resistant to wear.

- Graphene is the thinnest material ever isolated, despite this, it is up to 300 times stronger than steel and the most conductive material in the world.

- Add just 0.01% of graphene into concrete - responsible for around 8% of the world's CO₂ emissions - reduces its carbon footprint by approximately 30%.
Our graphene has a unique chemical fingerprint which makes it easy to use and disperse in a multitude of solvents, polymer resins, elastomers and water-based formulations.
About FGR

WHO WE ARE
- First Graphene (ASX:FGR) is an Australian technology and manufacturing company.
- World leading graphene manufacturer based in Henderson, Western Australia.
- Tier 1 partner at the Graphene Engineering and Innovation Centre (GEIC), Manchester, UK.
- New substance registration in United Kingdom (UK-REACH), Europe (EU-REACH) and Australia (AICIS) in place.
- Active membership of ISO standards committee for graphene registration.
- Market capitalization: **AUD$133m**
- Share price 50-day average: **AUD$0.24**

WHAT WE DO
- Producer of high performing PureGRAPH® products creating value in key markets.
- Quality leader in graphene materials – acknowledged by our customers.
- Robust 100 tonne/year modular manufacturing facility - built and operational today.
- Developed IP to mass produce commercial scale graphene for multiple products and industries.

CORE MARKETS
- Rubbers and elastomers – automotive, industrial and leisure.
- Cement and concretes – recycled, precast panels, ready mix and grouts.
- Composites and plastics – plastic parts, carbon and glass fibre, including boats, surfboards and swimming pools.
- Coatings – thermal, antistatic and anti-corrosion.
- Energy storage – supercapacitors, battery anodes, petroleum feedstock derived green hydrogen.

OUTLOOK
- With the production process and capacity “banked”, strongly focused on the commercialisation of PureGRAPH® and driving sales demand.
- Invest into new applications for emerging PureGRAPH® markets.
VEIN GRAPHITE RM’s
- Captive – ensures reliability
- No processing at mine
- In-house stock
- Low metals
- Large graphene plates

ELECTROCHEMICAL EXFOLIATION
- High Yield
- Single Step
- Unique to FGR
- Scalable/Low Cost
- Low waste

INDUSTRIAL FINISHING
- Well established
- Controlled Quality
- Finishing Options
- Scalable/Low Cost
- Low Waste

QUALITY ASSURANCE
- 6-sigma approach
- Industry leading measurement techniques
- ISO/TC229 aligned
- At-line testing
- C of A for each batch
About PureGRAPH®

• Highest performing graphene additive available at tonnage quantities

• PureGRAPH® powders contain pristine, high aspect ratio platelets with typical thickness of 5-10 carbon atoms

• Lateral sizes are carefully controlled in the PureGRAPH® range at 5µm, 10µm, 20µm and 50µm ensuring consistent and repeatable performance

• Easily dispersed, delivering multiple benefits across a range of materials

• PureGRAPH® AQUA products allow easier dispersion into water and solvent-based formulations, beneficial for specific applications including coatings, cement and rubbers

• Continued product development to make tailored PureGRAPH® platelet sizes and functionalised platelets – to aid formulation and extend applications.

PureGRAPH® 5 Scanning Electron Microscopy (scale bar = 20µm): This analysis of dried product powder shows aggregated powders of high aspect ratio graphene platelets. These particles disperse readily in solvent and polymer media.

PureGRAPH® 5 Transmission Electron Microscopy image of platelet edges, showing 8 layers thickness. An average of 6 layers was reported - Courtesy of University of Adelaide.

PureGRAPH® 5 Malvern Mastersizer analysis showing Dv(50) = 5µm and Dv(90) = 11µm i.e no large particle tail is present. Laser light scattering is used as a powder size quality control tool. PureGRAPH® products have very reproducible Dv(50) and Dv(90).
Executives and Board of Directors

Michael Bell
Chief Executive Officer
- International sales, engineering and business leadership expertise across a diverse range of industries
- 20 years’ experience in high growth across both SME and Corp. environments - former Senior Vice President of ST Engineering Group Singapore
- Bachelor of Science - Physics, Management Science University of Canterbury

Paul Ladislaus
Senior Process Engineer
- Chartered Chemical Engineer with 20 years’ chemicals experience in operational, design, project management and R&D roles
- Extensive particle manufacturing expertise with Huntsman and Thomas Swan.
- Master’s Degree in Chemical Engineering from the University of Cambridge

Aditya Asthana
Chief Financial Officer
- More than 15 years experience in finance and business across Australia and Asia
- Significant expertise in risk management, transformation and business turnarounds with Orica Ltd and its international subsidiaries
- Held a number of CFO and Director roles in Australia, Singapore and Indonesia.

Warwick Grigor
Non-Executive Chairman
- Respected and experience mining analyst
- Graduate of the Australian National University, with degrees in law and economics
- Former Chairman of Cannacord Genuity Australia Ltd

Michael Quinert
Non-Executive Director
- Founding partner of Quinert Rodda Lawyers
- Focus on capital raising and listing rule compliance
- Over 20 years experience with ASX-listed companies in the capacity as legal counsel and director, in the mining and technology sectors
- Non-Executive Chairman of West Wits Mining Ltd.

Dr Andy Goodwin
Non-Executive Director
- Ph.D. scientist with extensive leadership experience in innovation and new business growth with specialty chemicals industry
- 35 years in pharma & specialty chemicals with Sanofi, Dow Corning Corporation and Thomas Swan.
- Business leadership in carbon nanomaterials since 2012.
Sales and growth strategy

1. Global markets

Clear sales focus on immediate sectors include:

- Rubbers & Elastomers
- Composites & Plastics
- Cement & concretes
- Coatings
- Energy storage

2. New & innovative solutions

- Discovered new hydrodynamic cavitation process to convert petroleum feedstock into high-grade graphite and graphene.
- Applicable in lithium-ion battery anodes for electricity storage devices, also produces ‘green’ hydrogen - appealing to oil producers looking to enter the green energy market.
- Successful tonnage sales in polymer strengthening and wear resistance.
- Qualifying trials with composites and concrete.
- Progress in novel supercapacitor and battery materials.
Commercial sales team

Neil Armstrong
Commercial Manager – Composites & Plastics
- Chemical engineer with 10 years commercial experience
- Significant role in developing FGR’s production facility and facilitating early adopters of PureGRAPH®
- Previously held roles with Wear Systems Solutions

Todd McGurgan
Commercial Manager – Cement & Concrete
- More than 25 years experience in the global cement industry
- Former leadership position at Holcim Australian & NZ
- Previous roles include BASF, Cement Australia, Sunstate Cement and Readymix

Matt Curthoys
Commercial Manager – Marine Composites & Windfarms
- More than 25 years experience in the Marine industry
- Chartered Naval Architect in Europe and Asia
- Expertise designing, engineering and producing composite structures for America’s Cup and other boats

Recruiting
Commercial Manager – Rubbers & Elastomers
- TBC

Recruiting
Commercial Manager – Energy Storage
- TBC

Recruiting
Commercial Manager – Coatings
- TBC
Rubbers & Elastomers

**PureGRAPH® Advantage:**
- Robust supply
- Dependable quality
- Increased strength
- Increased durability
- Increased fire retardancy
- Easy dispersion
- Latex rubber compatible

TDI based polyurethane thermoset with <1% PureGRAPH® additive show improvements in tensile strength, elongation, abrasion and tear strength.
Rubbers & Elastomers

PureGRAPH® enhanced footwear
• Steel Blue product launch in 2021
• Scuff Cap, Outsole, Met Guard, Toe Cap and Midsole
• Lighter,
• Improved grip
• Improved wear resistance

PureGRAPH® enhanced wear liners
• ArmourGRAPH™ product line launch by newGen
• Tier 1 mining companies moving to adoption based on reduced cost of ownership.
• Iron ore trials (>12 months) at Pilbara WA show six times improved durability

PureGRAPH® enhanced rubber components
• Conveyor belts for bulk material handling applications
• Increased cut/tear properties
• Reduced abrasion loss
• Increased fire retardance

PureGRAPH® enhanced upcycled rubber products
• Increased strength
• Improved incorporation of rubber crumb
• Multiple adjacent opportunities
**Composites & Plastics**

**PureGRAPH® Advantage:**
- Robust supply
- Dependable quality
- Increased strength
- Increased durability
- Improved water & chemical barrier
- Easy dispersion
- High concentration plastic MBs available

Flexural stress/strength performance measured by ASTM D7264 three point bending of chopped glass fibre reinforced polyester-styrene resin pool composite vs. industry standards.
Composites & Plastics

PureGRAPH® GRP swimming pools

- Product launch by Aquatic Leisure Technologies – May 2021
- Graphene Nanotech incorporated into all pool products.
- 30% increased flexural strength
- 30% light-weighting
- Improved water resistance

PureGRAPH® GRP boats

- Boat launch - June 2021
- Increased flexural strength
- Increased stiffness
- Improved water resistance
- Moving to adjacent markets

PureGRAPH® enhanced HDPE oyster pots

- Increased yield strength
- Increased abrasion resistance
Cement & Concrete

PureGRAPH® Advantage:

• Robust supply
• Dependable quality
• +34% in compressive strength
• +27% in tensile strength
• Peer reviewed & published data
• Known mechanism – controlled hydration from high aspect platelets
• Enables use of recycled concrete as aggregate
• Ease of use in powder and aqueous dispersions

• After water, concrete is the most widely used material in the world.
• The use of cement-based concrete contributes ca. 8% of global CO₂ emissions
• Increasing the strength can potentially reduce cement use and associated CO₂ emissions by 30%.
Cement & Concrete

PureGRAPH® enhanced green concrete
- Portland cement is being substituted with green options such as geopolymer.
- PureGRAPH® provides increased mechanical properties.
- Improved integration of recycled concrete aggregate

PureGRAPH® enhanced concrete for structures
- Increasing compressive and tensile strength
- Improved corrosion resistance
- Reducing surface abrasion

PureGRAPH® enhanced prefabricated components
- Increasing compressive and tensile strength
- Reduced water permeability

PureGRAPH® protected concrete
- Reduced water permeability
- Improved corrosion resistance

Multiple PureGRAPH® opportunities along the cement value chain
Innovative Solutions – Dispersible Graphene

PureGRAPH® AQUA

For improved dispersion in polar systems
- Pre-dispersed hydrogel
- Pristine platelets have water spacers
- Easy formulation in paints, inks, cements and latex rubbers
- AQUA products available in all PureGRAPH® sizes.

Custom Functionalisation
For improved dispersion and bonding
- Bespoke chemical functionality for covalent resin bonding
- PureGRAPH® is ideal precursor for Thermal Thiol-Ene Click Chemistry deployed

Tailored PureGRAPH® functionality reproduced from Materials 2021, 14, 2830.
Supercapacitors:
• Patented process to manufacture metal oxide decorated graphene
• High capacitance materials for superior supercapacitors
• Pseudo capacitance giving high capacitance/area enabling high energy density storage devices
• Further testing in progress with WMG

Fuel Cells:
• Metal decorated graphenes are excellent de-oxygenation catalysts in hydrogen fuel cells.
• Potential platinum catalyst replacement
• Further development funded by UK government underway with the Manchester Fuel Cell Innovation Centre

Fig 1: SEM images of the graphene scaffold with metal oxide structures for use in pseudo capacitors or electrocatalysts
High Purity Graphite from Oil Feedstock

- **Patented process** funded by the U.K. Government to convert petroleum fraction to high purity Graphite/Graphene suitable for Li-Ion Anodes.

- Process creates **Hydrogen** as a valuable by-product; with no CO₂ generation (No combustion or burn off required).

- Resultant **Graphite** is high purity and optimized for a Li-Ion anode manufacture.

- Resultant **Graphene** can be used in composite anodes and cathodes for next generation Li-ion batteries.

- **Entry opportunity** for oil suppliers to participate in battery technology. Actively seeking and engaging with oil supply companies.

High-quality graphitic flakes from the process – SEM analysis

One-step conversion of oil fraction to graphite for Li-ion battery anodes.

High-quality graphitic flakes from the process – SEM analysis
Progress and recent FGR accomplishments

- Commercial relationship extended with planarTECH 26 FEBRUARY 2021
- Product discovery – mining bucket wear liner trial results point to a 6x improvement in lifespan 4 MARCH 2021
- MoU with Gerdau S.A. to open up Brazilian markets to PureGRAPH 9 MARCH 2021
- PureGRAPH product line to include water dispersed 10 MARCH 2021
- Research shows PureGRAPH benefits in thermoplastics 05 MAY 2021
- Patented process converts petroleum feedstock to graphite, graphene and green hydrogen 20 APRIL 2021
- PureGRAPH 50 added to product line 19 APRIL 2021
- Graphene catalysts for low-cost hydrogen fuel cells 11 MAY 2021
- Institutional placement to underwrite growth strategy 27 MAY 2021
- Strategic appointments made to the newly created commercial sales team 27 MAY 2021

2021
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