ASX Announcement

13 December 2017

A Greener Approach Towards the Fabrication of Graphene Oxide (GO)

HIGHLIGHTS

- Provisional patent lodged for fabrication of GO
- Environmentally friendly, scalable production method
- Potential to open up many GO applications to commercialisation

Advanced materials company, First Graphene Limited ("FGR" or "the Company") (ASX: FGR) is pleased to provide an update on its work with Flinders University (Flinders) on the fabrication of GO.

Background to the Vortex Fluidic Device

As previously advised, FGR has the rights to a 70% interest in the company that owns the intellectual property (IP) rights to the Vortex Fluidic Device (VFD), with the balance of the shares owned by the inventors.

The VFD has the ability to produce graphene from raw graphite and flake graphite concentrates, complementing the electrochemical exfoliation method used in the Graphene Cell that has been installed in the Henderson facility. The VFD can also be used as a secondary processing step to enhance and functionalise graphene products from the Graphene Cell.

Whilst the initial attraction of the VFD was its ability to make graphene, this exciting technology has implications for applications that extend into many aspects of industry, well beyond graphite and graphene. As an example, it is capable of accelerating and increasing the efficiencies of chemical and biochemical reactions which would otherwise be difficult to achieve. It has the potential to redefine organic chemistry.

The ground-breaking science used in the VFD relates to the interaction between centrifugal and gravitational forces which are witnessed when the unit operates at a 45^{o} angle. Unexpected phenomena in chemistry and physics occur, enabling exfoliation of a range of laminar materials in a controlled method, in contrast to high-energy processes such as wet ball milling or high power sonication.

The application of this technology to dynamic thin films with its ability for high heat and mass transfer, shear stress and micro-mixing can lead to the improvement in synthesis of polymers, chemicals and materials.

Graphene Oxide – Traditional Methods Have Issues

Graphene oxide (GO) can be made by a number of methods but most of them involve extensive use of toxic chemicals such as nitric acid, sulphuric acid and in some instances hydrofluoric acid, this latter acid being extremely dangerous and corrosive. These create environmental issues and added cost.

While GO has the potential to be used in many applications, such as coatings, filters, membranes and in batteries, existing production methods, associated costs and availability of supply have all inhibited the commercial advancement of these applications. Industry is searching for a safer, lower cost production method for GO that is scalable.

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ASX Symbol
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Flinders Test Work on Environmentally Friendly Graphene Oxide

With still a number of experiments underway, results thus far have established the potential to fabricate GO directly from the graphite ore with a percentage oxidation of approximately 23%.

Using samples of FGR's graphene the experiment was conducted using 30% aqueous hydrogen peroxide under continuous flow, where scalability is addressed at the inception of the science. Hydrogen peroxide was the solvent of choice simply because of the low cost. It is an environmentally benign solvent at low concentrations, widely available and acts as an effective oxidant, facilitating the exfoliation process.

A provisional patent application has now been lodged by Flinders, for the environmentally friendly fabrication of GO using the VFD and related Turbo Thin Film Device (T^2FD).

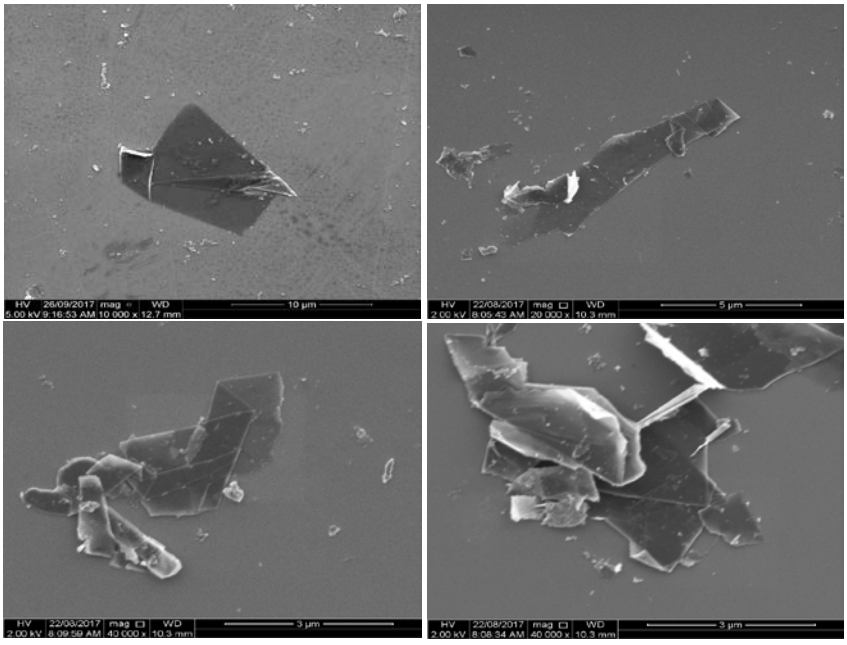

Figure 1: Scanning electron microscopy images of the exfoliated graphene sheets with approximately 23% surface oxidation. The graphene sheets were approximately 7-20nm in thickness.

CRC-P Grant for GO Research

In making application for the Cooperative Research Centres Projects Program – 4th Selection Round the Company had highlighted the Project would provide a new method to create (GO). The GO production research component of this Project will contribute to new learnings beyond the current Hummer or modified Hummer's method, and potentially discover a new way of processing GO which would be a world-first

A recent market report predicted the graphene market size will exceed US$200m by 2024. The report further stated GO was a key product element in the graphene market and could account for 40% of the total industry revenue share in 2024. The segment could grow with a CAGR above 35% owing to its extensive use in electronic equipment, biotechnology, as a surfactant and in catalytic oxidation. GO is used as electrode material for batteries, capacitors and solar cells.

About First Graphene Ltd (ASX: FGR)

First Graphene produces high quality graphene from high grade Sri Lankan vein graphite.

First Graphene seeks to develop graphene production methods and acquire graphene related intellectual property which can provide further revenue related opportunities.

About Graphene

Graphene, the well-publicised and now famous two-dimensional carbon allotrope, is as versatile a material as any other discovered on Earth. Its amazing properties as the lightest and strongest material, compared with its ability to conduct heat and electricity better than anything else, means it can be integrated into a huge number of applications. Initially this will mean graphene is used to help improve the performance and efficiency of current materials and substances, but in the future, it will also be developed in conjunction with other two-dimensional (2D) crystalline materials to create some even more amazing compounds to suit an even wider range of applications.

One area of research which is being very highly studied is energy storage. Currently, scientists are working on enhancing the capabilities of lithium ion batteries (by incorporating graphene as an anode) to offer much higher storage capacities with much better longevity and charge rate. Also, graphene is being studied and developed to be used in the manufacture of supercapacitors which can be charged very quickly, yet also be able to store a large amount of electricity.

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