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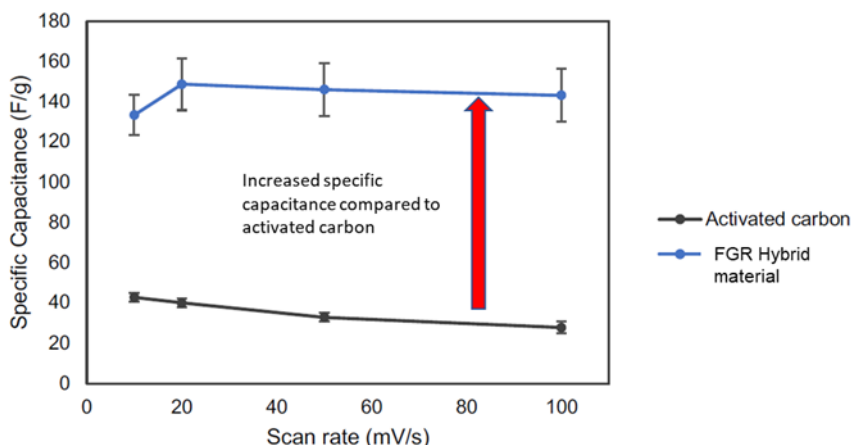
Graphene-based supercapacitor materials deliver 85% improvement in energy density levels

HIGHLIGHTS

- Continuing test work demonstrates 85% improvement in energy density and a 300% better capacitance than activated carbon cells
- Independent testing demonstrates PureGRAPH[®] hybrid active materials have specific capacitance multiple times greater than activated carbon
- Roadmap to high power and energy density devices established
- Relationships established with development partners for further optimisation of the supercapacitor devices

First Graphene Limited (ASX:FGR; "First Graphene" or "the Company") is pleased to announce the achievement of a critical milestone on its program to develop high performing supercapacitor materials. Previously, the Company reported that high capacitance "hybrid active materials" could be successfully scaled using its unique electrochemical process technology. These novel materials demonstrated high capacitance per unit area when tested in a simple cell prototype. Recent work has focused on the development of an optimised bill of materials for a supercapacitor device to deliver high energy and power densities.

First Graphene is now pleased to announce that following multiple laboratory trials, the Company has demonstrated that in a standard test cell, PureGRAPH[®] hybrid active materials outperform leading activated carbon materials over 100 cycles. Figure 1 shows the PureGRAPH[®] hybrid active materials have a specific capacitance of 140 farads per gram (F/g) while activated carbon cells typically have a specific capacitance of 35 F/g. This clearly demonstrates that PureGRAPH[®] hybrid active materials can be successfully formulated into an electrode slurry for use in device manufacture, retaining their high specific capacitance and operating at high charge/discharge rates.



Independent testing confirms FGR Hybrid material outperforms activated carbon used in commercially available supercapacitors

Fig.1. Specific Capacitance of PureGRAPH[®] hybrid active materials vs. Activated Carbon

A detailed literature review indicates that further progress to higher power density and energy density devices requires the development of improved supercapacitor devices. The research focus switched to an improved bill of materials for the device, which includes enhanced electrolyte and separators. Published research indicates that an optimised cell with high capacitance operating at high voltage can achieve the "10 plus 10" target of power density above 10kW/L and energy density above 10Wh/L.

Alternative electrolytes have been tested by the Company to deliver high power and energy densities. In an initial test with a dense, protic, aqueous electrolyte to enable a higher voltage window, First Graphene demonstrated an increase in energy density of 85 per cent.

Further electrolyte modifications are currently under development and the Company has established relationships with leading experts in cell design and electrolyte materials. By identifying ideal PureGRAPH® hybrid active materials and electrolyte combinations, First Graphene anticipates world leading performance with power density greater than 10kW/L and energy density greater than 10Wh/L.

Commercialisation

Having demonstrated a significant improvement in performance over activated carbon, First Graphene is now in a strong position to develop commercial partnerships with large supercapacitor manufacturing companies globally looking to develop the next generation of supercapacitors. There are currently no agreements in place or an assessment of economic impact available yet.

This is a key technological breakthrough for the Company, which allows improved access to a completely new market-segment globally.

The market and applications

The supercapacitor device market is projected to grow from US\$409 million in 2020 to US\$720 million by 2025 at an expected CAGR of 12.0 per cent. The growth of the market is driven by increasing demand in energy harvesting applications and rising use of supercapacitors in trains and aircraft. Moreover, the increasing global demand for electric vehicles is likely to fuel the growth of the market.¹

Potential large volume applications include twinned supercapacitor-battery power supplies in which the supercapacitor provides peak power smoothing during acceleration or regenerative braking, reducing the load on the batteries and extending battery life.

The Company has completed a thorough review of supercapacitor devices, including desktop analysis and device testing of available high performing devices. Current best in class devices have power density above 10 kW/L and energy density above 5 Wh/L. To achieve this, the cell must have high specific capacitance and the ability to operate in a high voltage window.

Energy storage technologies

Supercapacitors, which are based on electrical double layer capacitance (EDLC), offer rapid charging and discharging giving a high-power density. These supercapacitors usually use activated carbon as a high surface area charge storage medium. They do not depend on a

¹ https://www.marketsandmarkets.com/Market-Reports/supercapacitor-market-37140453.html?gclid=EAiaIQobChMIibiU3cGq4wIVxrHtCh1UYwleEAAYAiAAEgLqIPD_BwE

chemical reaction as they work on charge separation within the device. This means EDLC supercapacitors are stable and can typically withstand many charge/discharge cycles.

For electric vehicles (EVs), an ideal energy storage device combines a chemical battery with high energy density (to enable long range driving) coupled with a supercapacitor that can rapidly charge and discharge to effectively manage periods where high power is needed for relatively short times, such as when starting and stopping. This will extend the battery life and ultimately extend the range of the vehicle².

An ideal route to this combined system is via pseudocapacitor technology, where charge storage occurs through the electrical double layer capacitance mechanism and rapid redox reactions between the ions in the electrolyte and the active materials on the electrode surface. Pseudocapacitance can significantly increase the performance of a supercapacitor. First Graphene's PureGRAPH[®] hybrid active materials has been shown to be an enabler to achieving pseudocapacitance.

First Graphene Managing Director and CEO Michael Bell said: *"We continue to make good progress in the rapidly emerging market for energy storage materials. We have proven that we can manufacture robust, high capacitance materials based on our PureGRAPH[®] products. Our next challenge is to optimise performance with other device components, with a particular focus on a suitable electrolyte. We have established important strategic relationships to do this."*

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About First Graphene Ltd (ASX: FGR)

First Graphene Ltd. is the leading supplier of high-performing, graphene products. The company has a robust manufacturing platform based upon captive supply of high-purity raw materials and an established 100 tonne/year graphene production capacity. Commercial applications are now being progressed in composites, elastomers, fire retardancy, construction and energy storage.

First Graphene Ltd. is publicly listed in Australia (ASX:FGR) and has a primary manufacturing base in Henderson, near Perth, WA. The company is incorporated in the UK as First Graphene (UK) Ltd. and is a Tier 1 partner at the Graphene Engineering and Innovation Centre (GEIC), Manchester, UK.

PureGRAPH[®] Range of Products

PureGRAPH[®] graphene powders and **PureGRAPH[®] AQUA** pastes with lateral platelet sizes of 50 μ m, 20 μ m, 10 μ m and 5 μ m, as well as **PureGRAPH[®] MB-LDPE 20-30** and **PureGRAPH[®] MB-EVA** masterbatches for thermoplastics, and **PureGRAPH[®] MB-EVA Bitumen** masterbatch, are available in tonnage volumes. The products are high performing

ASX ANNOUNCEMENT



additives, characterised by their high quality and ease of use.

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Frankfurt: FSE:M11

USA OTCQB: FGPHF

With authority of the board, this announcement has been authorised for release by Aditya Asthana, Chief Financial Officer and Company Secretary.