Li-S Energy

JULY 2022

NEWS

TAKING LI-S TO NEW HEIGHTS

There is something special about seeing new battery technology flying high!

After the success of our 4-layer lithium sulphur (Li-S) cell testing, we built a series of 10-layer Li-S pouch cells with BNNT and Li-nanomesh ready for cycle testing.

An advantage of 10-layer test cells is that they have sufficient capability to power small devices. So, prior to commencing controlled cycle testing, we tested the cells powering a small commercial drone.

After removing the existing lithium cells, we replaced them with two small 10-layer lithium sulphur test cells. The cells were allowed to hang freely from the drone *(as pictured above)*, as our test cell dimensions are different to the original drone battery pack.

The drone test flights were successful, with the drone flying high above an AFL sports ground, and reaching the maximum radio signal range of the drone remote controller.

Comparing the weights and capacities of the original drone cells to our Li-S test cells was revealing. Our Li-S cells achieved over 2.2x the gravimetric energy density *(see page 5 for more detail)* compared to the original cells supplied with the drone. This is extremely encouraging as the small 10-layer Li-S cells carry a very high percentage of packaging and 'dead weight'. As we scale up to commercial cells we expect performance should continue to improve.

Scientific battery performance testing involves highly rigorous methodologies and detailed data analysis — it's not always the most exciting activity — so it was great to witness the excitement of our scientific team as they watched the Li-S battery technology they created flying high above them. While there are many steps in our journey towards commercialisation, this early battery test flight 'step' was a very special moment.

Ben Spincer
Chairman

INSIDE THIS EDITION

GMC TECHNOLOGY & INNOVATION SUMMIT
DR LEE FINNIEAR

MANUFACTURING MATTERS FRONT AND CENTRE IN GEELONG

Our CEO, Dr Lee Finniear, was pleased to present to the Geelong Manufacturing Council at their recent Innovation Day. The panel included a number of successful manufacturers in the region, with wide ranging discussion on supply chain issues, revitalising Australian manufacturing and the nation's need for sovereign manufacturing of critical products during these increasingly uncertain times.

Lee stressed both the need for a National Battery Manufacturing Strategy, and the importance of advancing our sovereign capability for lithium processing from ore to lithium foil. Currently, Australia exports 46% of the global supply of lithium ore, but relies completely on foreign ore processing, having to buy back lithium products at vastly increased prices.

This issue is becoming increasingly pertinent as future batteries will require lithium products and local manufacturing will be critical if we are to develop large scale Australian production of new battery technologies.

GMC TECHNOLOGY & INNOVATION SUMMIT

MANY HANDS MAKE LIGHT WORK

As we continue on our path to commercialisation, one of the key optimisation focuses is the performance of the electrolytes in our cells. To help drive this outcome we have joined the Future Battery Industry Co-operative Research Centre (FBICRC).

Under the umbrella of the FBICRC, we have joined a multi-disciplinary team of industry participants and university scientific personnel focused on driving the development of new ionic liquid and polymerised solid-state electrolytes. The project is headed by Professor Maria Forsythe of Deakin University, and is co-funded by the Federal Government through the FBICRC program.

FUTURE BATTERY INDUSTRIES CRC

$5M FEDERAL FUNDING BOOSTS LI-S ENERGY 2MWH SCALE UP

Under its Trailblazer Universities Program, the Federal government has awarded $50M to the Recycling and Renewable Energy Commercialisation Hub lead by Deakin University, with $5M of this funding directly contributing to Li-S Energy R&D and our 2MWh pouch cell production facility.

We recently announced signing a Heads of Terms (HOT) with Deakin University to acquire 1000sqm of industrial space and additional laboratories at the Waurn Ponds Campus in Geelong to build the 2MWh pouch cell production facility.

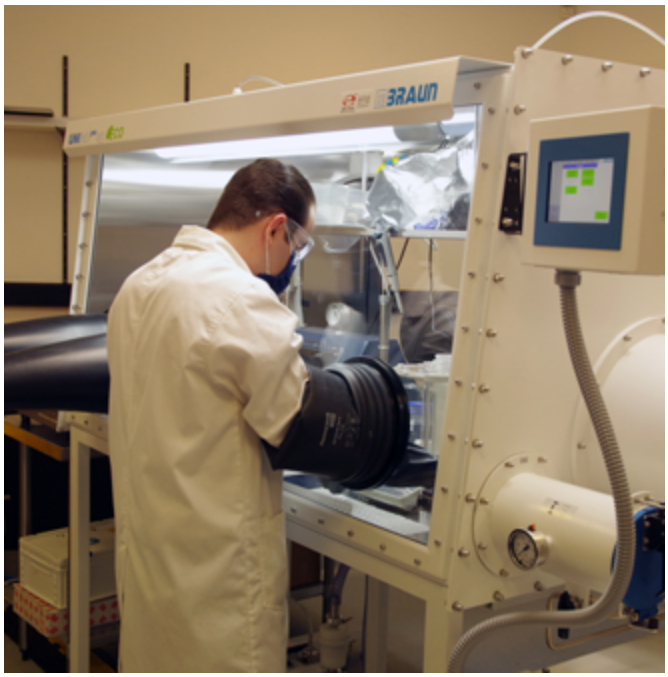
Combined with our existing funds, the Trailblazer contribution helps support our 3-phase commercialisation plans:

- Phase 1 – core R&D, materials & cell design optimisation
- Phase 2 – small scale pilot cell production, including roll-to-roll cathode coaters, slurry preparation, lithium cutting, cell stackers, electrolyte filling and cycle testing equipment
- Phase 3 – 2MWh Production facility including extensive dry rooms, clean rooms and fully automated robotic pouch cell production line.

Our Phase 2 equipment has already arrived and is in the process of being commissioned. Once complete, this new set up will enhance enhance our ability to produce multi-layer pouch cells with up to 50 layers for cell testing purposes.

We have now started Phase 3 facility design. The 2MWh production line will enable us to produce thousands of high-quality, matched multi-layer pouch cells. Product manufacturers can then be supplied — not only with individual test cells — but with the substantial matched cell volumes needed for extended electrification trials using Li-S Energy batteries.

We appreciate the support of the Federal Government and Deakin University in securing this Trailblazer co-funding.



LI-S ENERGY ON THE INTERNATIONAL STAGE

AS OUR TECHNOLOGY CONTINUES TO SCALE, WE'VE BEEN BUSY BUILDING RELATIONSHIPS WITH MAJOR INDUSTRY PLAYERS OVERSEAS.

In March & April, CEO Dr Lee Finniear and CTO Dr Steve Rowlands, visited a number of **key European companies** with the goal of bridging collaborations, sharing ideas and learning more about cutting-edge equipment.

Meetings were held across Spain, France, Germany and the UK with companies involved in electric vehicles, battery materials, battery production and battery research and development.

We enjoyed a very successful trip and look forward to sharing developments as these valuable relationships progress.

Fraunhofer is the largest research organisation in Germany with over 30,000 staff.

IMLB2022

Last month we were proud to sponsor the **International Meeting on Lithium Batteries 2022** in Sydney. This global conference brought together the best scientific professionals from around the world to discuss advances in lithium battery electrochemistry.

In its 20+ year history, this was the first time the event had been held in Australia. Over 800 delegates attended, with each of them receiving a conference satchel emblazoned with our logo, helping raise the awareness of Li-S Energy among the leading scientific minds in the battery community.

THE BATTERY SHOW
The Expo for Advanced Batteries

In June we also attended **The Battery Show Europe and the Electric & Hybrid Vehicle Technologies Expo** in Stuttgart, Germany.

These major conferences had over 550 exhibitors plus presentations from BMW, Mercedes, Scania, Volvo, Volkswagen, BritishVolt, NorthVolt, ItalVolt and many others.

We were excited to create new opportunities for our transformative technology as we met key executives at the event.

Batteries 101

NEW TO THE INDUSTRY OR NEED TO BRUSH UP ON YOUR KNOWLEDGE? THERE'S A LOT OF 'TECH TALK' IN THE BATTERY WORLD, SO OUR COLUMN **BATTERIES 101** WILL HELP US ALL BY DETAILING KEY COMMON BATTERY TERMINOLOGY AND CONCEPTS.

There are many different performance measures in the Battery industry, each designed to explain how a battery can deliver different performance characteristics for different devices and use-cases. Here are a few of the most important ones you may have heard of:

VOLUMETRIC ENERGY DENSITY

This is the amount of energy a cell can hold per unit volume. It is often expressed in units of Watt hours per litre (Wh/l). Volumetric energy density is particularly important for devices where there is very little space for the battery, so the size of the battery is more important than the weight – examples include mobile phones, smart watches and laptop computers.

GRAVIMETRIC ENERGY DENSITY

This is the amount of energy a cell can hold per unit weight. It is often expressed in units of Watt Hours per Kilogram (Wh/kg). Lithium-ion batteries typically– have a gravimetric energy density of 200 Wh/kg or less, whereas Lithium sulphur batteries have the potential to reach well over 400 Wh/kg. Gravimetric energy density is particularly important for devices that use battery power to move them – such as electric vehicles, drones and electric aviation.

CHARGE CAPACITY

This is a common term for the maximum capacity a cell can hold. It is often expressed in milliamp hours (mAh) or Amp hours (Ah), and is paired with the voltage of the cell. The total energy a cell holds is the charge capacity (Ah) multiplied by the cell voltage (V), giving a total in Watt Hours. Charge Capacity is often advertised on commercial batteries.

GRAVIMETRIC POWER DENSITY (ALSO CALLED SPECIFIC POWER)

This is a measure of how rapidly a cell can deliver energy per unit weight. It's units are usually Watts per kilogram (W/Kg). This is particularly important for devices that need to minimise weight and also need to discharge and charge cells rapidly (high C rate requirement).

SPECIFIC CAPACITY

This is a scientific term used to establish the effectiveness of the active material in a battery. Units are typically in milliamp hours per gram of active material (mAh/g). It allows researchers to perform direct measurement of active material performance without taking into account the weight of other battery components such as packaging, separators and current collectors.

C-RATE

This is a measure of how fast a cell delivers or receives energy. In simple terms a 1C rate is a current draw sufficient to fully discharge the cell in 1 hour. A 4C rate would complete the same full discharge in 15 minutes. The C Rate is useful as it can be applied irrespective of the size of cell. For example, a 100Wh cell at a 1C discharge rate would deliver 100Amps for 1 hour before full discharge, whereas a 1Wh cell at 1C would deliver 1 Amp for 1 hour before full discharge. The C rate is important to understand how fast a device is able to charge or discharge a battery cell, and is often advertised on larger rechargeable batteries.