ASX ANNOUNCEMENT

FOR IMMEDIATE RELEASE TO THE MARKET

PPK GROUP LIMITED – ASX Code: PPK

18 May 2021

BNNT FACILITATES DEVELOPMENT OF REVOLUTIONARY LITHIUM SULPHUR BATTERY

PPK Group Limited (ASX Code: PPK) is pleased to announce that its 48% owned subsidiary, Li-S Energy Ltd, together with its partner and fellow shareholder Deakin University has developed a revolutionary new lithium sulphur battery utilising the Boron Nitride Nanotubes (BNNT) technology. Attached to this announcement is the release from Deakin University detailing specifics of the new battery. PPK congratulates the Deakin scientists and the team at Li-S Ltd on this outstanding result.

The Cutting-Edge Super Material "BNNT" Demonstrating its Commercial Promise.

PPK has in prior announcements described the significant potential of high purity BNNT. Historically BNNT could only be produced in very small quantities, inhibiting the commercial applications for this 'super material' despite its unique properties. BNNT Technology Limited (BNNTTL) in which PPK holds a 50% interest, is using patented Deakin technology to help solve this problem. BNNTTL has recently achieved a major breakthrough by demonstrating production of 1Kg of BNNT over a 5-day period from a single production module. This results in an annual BNNT production estimate of 50Kg per annum per module whilst achieving a >95% purity. The total capital cost of a single module is $850,000. Only two years ago less than 1kg per annum could have been produced.

The development of the innovative new lithium sulphur battery is very exciting for PPK as a key component of the breakthrough is the use of BNNT in the battery. The improving ability to produce BNNT in more useful quantities at declining unit cost further enhances the commerciality of Li-S Energy Ltd.'s lithium sulphur battery breakthrough.

PPK executive Chairman Mr, Robin Levison said:

"For me personally, this is a really exciting moment for PPK. What we see here is a real-life tangible application of BNNT to facilitate a genuine technological breakthrough with global commercial potential. This new type of lithium sulphur battery demonstrates how the unique attributes of this truly amazing product can be realised in practice."

Lithium Sulphur Battery Breakthrough

Lithium Sulphur (Li-S) batteries are considered next-generation batteries with a significantly higher energy capacity than existing lithium-ion batteries. However, to date, they have a severe limitation with lifetime performance, typically degrading to the point of failure over very few charge and discharge cycles.

Deakin's Nanotechnology research team has developed an innovative use of the BNNT, to improve the performance of Li-S batteries – retaining the high energy capacity and also avoiding significant degradation over more than 450 charge/discharge cycles. Testing to further increase the charge/discharge cycle capacity continues. The new lithium sulphur battery represents a step-change in the global battery industry.

Li-S has lodged two key provisional patents covering this breakthrough and the technology covered by the patents has the potential to make large scale manufacturing of lithium sulphur batteries commercially viable for the first time.

Li-S Energy intends to optimise the design, then scale up the production of the new batteries over the coming years, for which there are almost unlimited potential uses – including the possibility of an electric car that needs charging only every 1000 kilometres, a phone with a one-week battery life, off-grid solar/battery street-lighting and drones with several hours of flight time. Please refer to the attached media release from Deakin University.

Li-S Energy Limited (LIS) Well Positioned for Future Growth

After completing its recent A$20 million pre-IPO capital raising, LIS is in a strong position to further its objective of developing and commercialising its battery breakthrough employing the new BBNT infused lithium sulphur technology.

PPK executive Chairman Robin Levison said:

"Li-S is now in a great position to capitalise on this world first battery technology development by the Deakin scientists after the successful close of its recent A$20 million capital raise. This coupled with the pending IPO capital will ensure Li-S is well resourced to progress its battery project with Deakin University using BNNT technology."

BNNT's Potential Use in Multiple Projects

As previously disclosed by PPK, there is potential to use BNNT in a revolutionary manner as a component of multiple other commercial products. PPK is well placed to capitalise on this through its vertical integration strategy of partnering with other leading technology developers through various joint ventures including:

1. Working with Craig International Ballistics Pty Ltd (in which PPK holds a 45% interest) and BNNT Technology Limited, to investigate how BNNTs can be used in the production of bullet resistant glass and body armour to produce lighter, more effective products.

2. Its Strategic Alloys Pty Ltd (PPK 45%) joint venture with Amaero International Limited (ASX:3DA) and Deakin University to develop a super strength aluminium alloy utilising BNNTs to significantly improve mechanical properties. BNNTs will also be used in conjunction with Amaero's high operating temperature aluminium alloy product.

3. Joining with David Dunn and Deakin University in the 3D Dental Technology Limited venture (PPK 45%) to develop new nanocomposites for various dental materials. These can be used in products such as dental ceramics to produce enhanced micro-tensile strength that is significantly superior to current ceramics.

Robin Levison, PPK executive Chairman commented:

"As Chairman I'm really thrilled at what we and Deakin have announced today and the excitement it generates in the potential future of both Li-S and BNNT products. As a significant investor in both BNNT Technology Ltd, as well as Li-S Ltd., the shareholders of PPK are uniquely positioned to benefit from these recent technological breakthroughs".

This announcement has been made and authorised by the PPK Group Board.

For further information contact:

Robin Levison
Executive Chairman of PPK Group Limited
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Media release

DEAKIN UNIVERSITY

Nanotechnology creates next-generation powerful battery technology

Tuesday, 18 May 2021

Mobile phones with a one-week battery? Electric cars with a 1000 kilometre range? Drones that fly for hours between charges?

These pipe dreams could soon be a reality after researchers at Deakin University, in partnership with Australian start-up Li-S Energy Ltd, developed an innovative new lithium sulphur battery that represents a step-change in the global battery industry and

Lithium Sulphur (Li-S) batteries are considered next-generation batteries with a significantly higher energy capacity than existing lithium-ion batteries. However, to date, they have a severe limitation with lifetime performance, typically degrading to the point of failure over very few charge and discharge cycles.

Deakin's Nanotechnology research team has developed an innovative use of the nanomaterial, Boron Nitride Nanotubes (BNNT), to improve the performance of Li-S batteries – retaining the high energy capacity and also avoiding significant degradation over more than 450 charge and discharge cycles (see Figure 1).

There were three key challenges to overcome in creating a high-performance Li-S battery:

1. Engineering a conductive interface within the sulphur cathode;
2. Controlling the structural integrity of the cathode over extended cycling; and
3. Preventing dendrite growth from the lithium metal anode.

Each challenge involved significant aspects of innovation using BNNT and other integrated materials, which together facilitated the optimum functional relationship between lithium and sulphur in an energy storage device.

Li-S Energy has now lodged two key provisional patents covering the function of BNNT within the lithium sulphur battery chemistry. The new technology covered by these patents has the potential to make large scale manufacturing of lithium sulphur batteries commercially viable for the first time.

Li-S Energy intends to optimise the design, then scale up the production of the new batteries over the coming years, with almost unlimited potential uses – including the possibility of an electric car that needs charging only every 1000 kilometres, a phone with a one-week battery life, off-grid solar/battery street-lighting and drones with several hours of flight time.

The research and initial production have been undertaken in Deakin's advanced manufacturing precinct in Geelong, leveraging the expertise of Deakin's Institute for Frontier Materials and the facilities of Deakin's ManuFutures scale-up accelerator. The critical BNNT material is provided by another ManuFutures tenant, BNNT Technology Ltd, and Li-S Energy's initial production plant is slated for Deakin's new *ManuFutures 2* facility, a $20 million partnership investment project supported by the Victorian Government's Higher Educational Strategic Infrastructure Fund.

Li-S Energy and BNNT Technology Ltd are both joint ventures between Deakin and the ASX-listed PPK Group. Li-S Energy has recently raised $20 million to support the ongoing development of this Deakin technology.

Professor Iain Martin, Vice-Chancellor at Deakin University said: "This is an incredible achievement by our outstanding researchers, working with a visionary partner. This success validates Deakin's commitment and investment in the ManuFutures facility to create regional advanced manufacturing jobs based on Australian intellectual property. This development exemplifies our capabilities in turning Ideas to Impact and helps ensure we will continue to play a pivotal role in the transformation of our region."

Dr. Lee Finniear, CEO of Li-S Energy Limited said: "We have achieved a significant innovation breakthrough with our Li-S battery technology at a time when the world is demanding better batteries and more efficient energy storage devices. The commercialisation journey for Li-S Energy Limited has begun and is on track to showcase this Australian company as a recognised leader in this exciting industry."

Lead Deakin researchers, Alfred Deakin Professor Ying (Ian) Chen and Dr Baozhi Yu said: "These results are the culmination of 10 years of research into the development of lithium sulphur batteries and how that is influenced by advanced nanomaterials. The belief and investment in the research program from Li-S Energy have now enabled us to bring our research toward a commercial reality."

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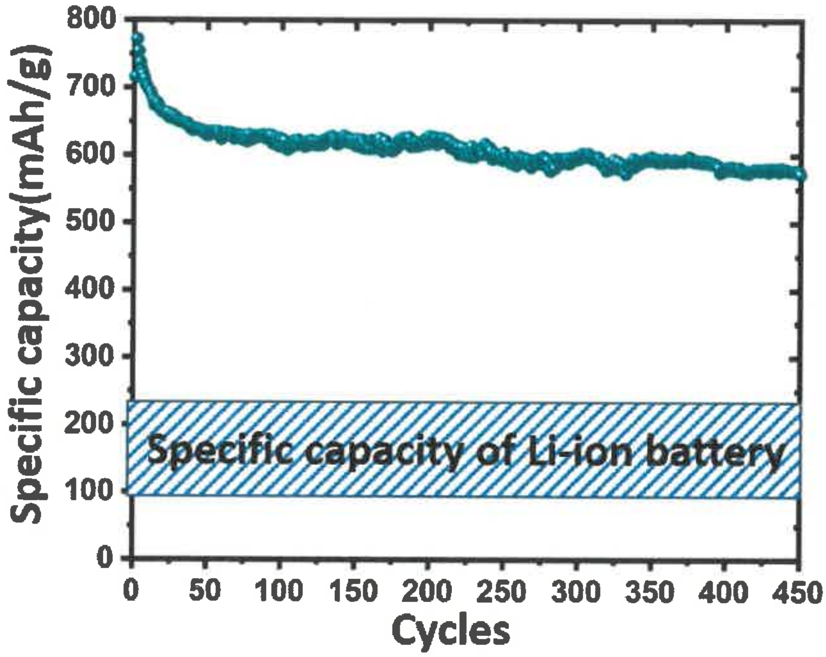
Figure 1. Li-S battery test results after 450 continuous cycles. Specific capacity has been maintained at greater than 550mAh/g which is in the region of 3 times the specific capacity of current Lithium ion batteries.



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