Doubling the lifetime of lithium-air batteries

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Since they were first commercialised in 1991, lithium-ion batteries have come a long way. The global market is expected to reach EUR 30 billion by 2019, with applications in almost every industry – from intermittent renewable energy storage devices to smartphones and electric cars.

But as the machines they power become greedier, engineers across the world have had to start looking into alternatives with a higher storage capacity. One of these alternatives resides in lithium-air (Li-air) technology – batteries consisting of metal-based anode and air-cathode which constantly extract oxygen from the ambient air.

'The main advantage of a lithium-air battery is its high energy density, which is theoretically 10 times higher than that of lithium-ion batteries,' explains Prof Qiuping Chen, associate Professor at the Polytechnic University of Turin and coordinator of the STABLE project. 'The biggest challenge, however, is to improve their lifecycle which was only of 50 cycles maximum before the STABLE project.' This figure pales in comparison to that of lithium-ion batteries, which can reach from 400 to 1200 cycles over their lifetime.

STABLE's objective was straightforward: increasing this capacity from 50 to 100-150 cycles and demonstrating this breakthrough in functional cells within three years, with the emerging market of electric car batteries in mind. 'The project is a complete success in this regard, with a life that has reached 151 cycles,' enthuses Prof Chen. 'Although the impact on car mile range per cycle largely depends on the energy density , dimension and quantity of battery cells, we expect it to be quite important.'

To get to this result, Prof Chen and his team focused their research on battery anode, cathode, electrolyte materials and technologies, as well as assembly techniques for batteries which play a central role in their performance, cost and environmental impact. 'We improved the lifetime and cyclability of Li-air batteries by different means. First we found highly active bifunctional catalysts capable of effectively regenerating the battery. Then, we protected the Lithium anode from dendrites formation using suitable membranes, and finally we increased the stability of the electrolyte to enhance solubility of Li_2O_2 and avoid cathode clogging.'

Prof Chen believes that the multidisciplinary nature of the consortium, with partners specialised in material sciences, electrochemistry, battery assembly design and others, is what made this success possible. And it should also contribute to its future commercialisation.

'This was an early stage research project,' Prof Chen concludes. 'We successfully reached our objectives but only validated these results at laboratory scale. We still have a lot of work ahead in order to bring our new batteries to the market, with challenges ranging from raw materials production to the improvement of Li-air battery technologies and equipments.'

More information: For further information, visit the STABLE project website: www.fp7-stable.com/

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