Axeon – Lithium-ion batteries for electric vehicles

Project background

Electric vehicles (EVs) produce zero carbon emissions at the point of use, and even with the current mix of electricity generation they offer the cleanest transport option. However, a major barrier to the widespread adoption of EVs has been the lack of affordable high-capacity batteries. Electric vehicles are now being transformed by lithium-ion batteries, which offer high energy density and long life at an economic cost.

Axeon Holdings plc is a leading technology developer, designer and manufacturer of complete Lithium-ion battery systems for Electric and Hybrid Electric vehicles (EVs and HEVs). Axeon has successfully completed two projects funded by the Department for Transport under the Energy Saving Trust's Low Carbon R&D programme, achieving the project target of improved performance automotive batteries at lower costs. During the two year programmes Axeon has developed new Lithium-ion batteries for use in a fully electric commercial vehicle and in an electric small city car.

The project aims were to develop a cheaper and more stable Lithium-ion battery technology for installation in passenger and commercial vehicles. The projects were led by Axeon and supported by Modec, one of the UK's leading suppliers of zero emission commercial vehicles, and Zytek, a UK automotive engineering group.

Technology

Several Lithium-ion battery chemistries have become available over recent years, each with different profiles. Axeon sought to increase the energy density of electric commercial vehicle batteries, by custom designing an improved 300 Ah Lithium Iron Phosphate cell, using its expertise in cell pack design and assembly methods. This required the design and manufacture of a new battery layout and housing structure as well as a new Battery Management System, sophisticated software that monitors the state of a battery and measures and controls key operational parameters.

Axeon's design and manufacturing system is set up to meet the high reliability criteria of automotive companies with full component and process traceability. All cells are bar-coded to ensure full traceability. Cells are subject to extensive cell testing on arrival, which includes capacity, voltage and impedance testing. Finished automotive battery systems receive range tests as well as full inspection and electrical checks.

Case study

Performance

The larger battery was designed for use in a Modec zero emission 5.5 tonne commercial vehicle. The installed capacity of the battery was increased from 51kWh to 81kWh; independent tests over an urban delivery cycle on a single charge suggested a 35% improvement. With a modified drive train the average acceleration time to 20mph was 4 sec and to 30mph was 9.5 sec.

The larger battery is predicted to have over 80% of the original capacity still available in the cell after 1,000 cycles. The current extrapolated data shows that it should reach over 1,500 cycles, equivalent to 187,500 miles of driving, a three-fold improvement over previous chemistries.

The second project proved that Lithium Iron Phosphate cells deliver superior efficiency over the previously available chemistries that were used in small electric city cars. Lithium Iron Phosphate cells hold their charge much better than previously-used sodium cells and because of this charge efficiency the running costs for these batteries are lower.

Benefits of the technology

Lithium Iron Phosphate batteries have a very good safety profile, clearly a prime consideration for vehicles. They also offer good high current discharge performance, an excellent cycle life performance and good cost-down potential for the future, particularly as the volume increases.

Axeon's new commercial vehicle battery can deliver a range of 125 miles on a single charge. This allows a vehicle using this battery to travel further before being recharged and thus provides a more attractive option to fleet managers by increasing the commercial viability of such a vehicle.

Next steps

This project has enabled Axeon to design and develop new battery capability with extended range, which should increase the attraction of commercial electric vehicles and, subject to further testing, Modec may launch vehicles powered by Axeon's new extended range batteries in 2009. For the small city car newer cells that provide higher energy density have since been developed – these are likely to be more suitable for this application, and Axeon plans to test these later in 2009. The findings from the city car project will be applied to Axeon's on-going development of new small car batteries, which will hopefully be supported in a demonstrator project of 40 vehicles for the Technology Strategy Board.

Lawrence Berns, CEO of Axeon said, "Axeon is committed to staying at the forefront of battery pack technology. This funding from the Energy Saving Trust enhanced our ability to meet our customers' needs for the development and manufacture of high-performance electric vehicle batteries. The knowledge gained during the project is now being built on and deployed for other applications, increasing the range of electric vehicles that can be developed for the market".

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