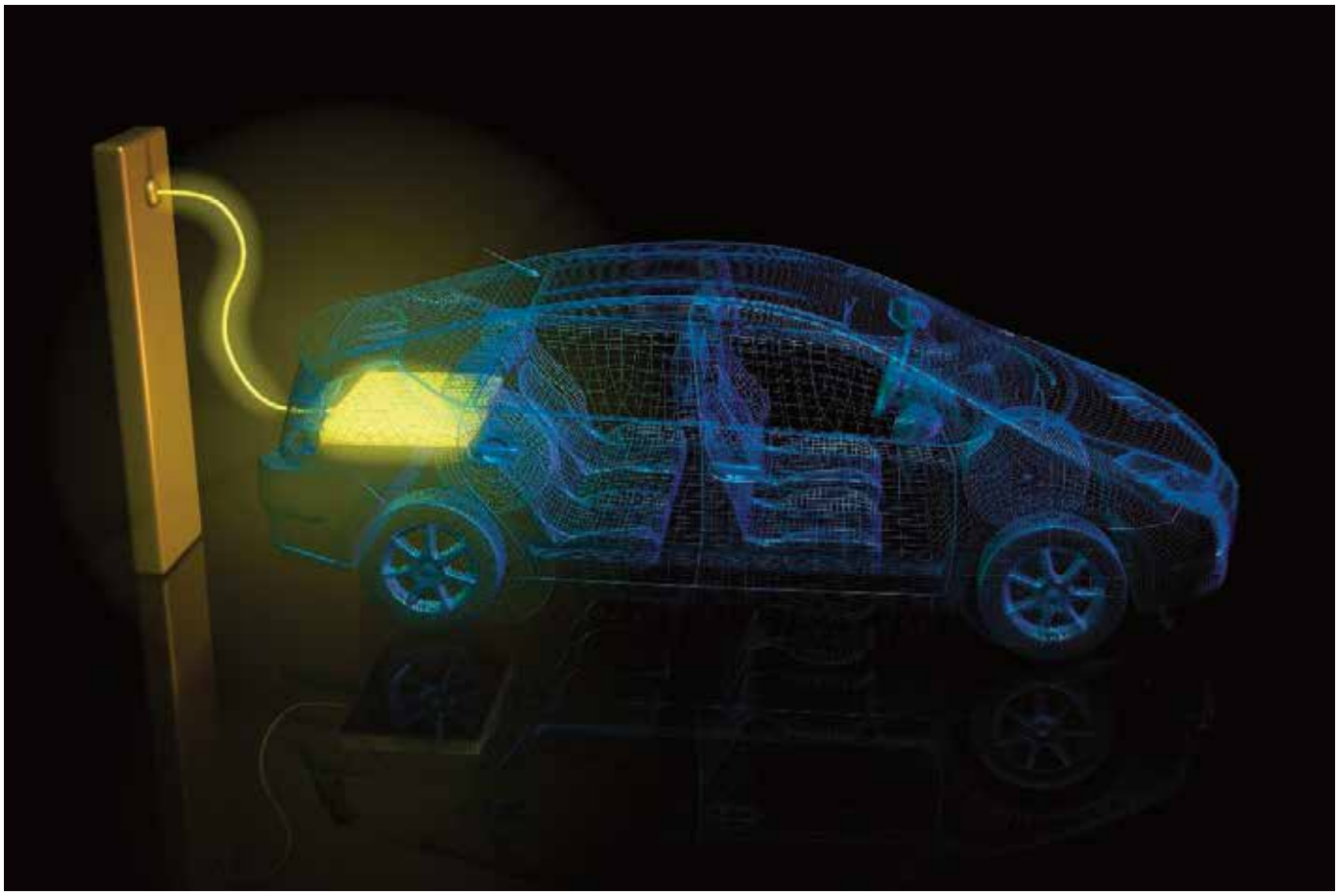

DESIGNING THE BATTERIES OF THE FUTURE

EDEM and SIMULIA collaborate to advance the use of simulation for Electric Vehicle battery design and performance

The Electric Vehicle (EV) market is growing quickly (45% increase in sales globally in 2017[1]), and an increasing number of automotive manufacturers are announcing plans to move to electric and hybrid-focused product lines. This growth is putting increasing demand on the battery manufacturing sector as EV suppliers demand batteries that deliver longer driving ranges and shorter recharge times, all while being smaller and lighter in size. With the EV sector expected to account for 90% of lithium-ion battery usage by 2025[2], battery producers are under pressure in the coming years to design and deliver these batteries of the future.

BUILDING A BATTERY

A typical battery consists of three parts—electrodes (anode and cathode), separator, and electrolyte. The production of electrodes is a complex, multi-stage process that begins with powdered materials such as graphite, binding agents, and active materials (e.g. lithium oxide). These materials go through a series of mixing, coating, calendaring, cutting and folding processes until wafer-thin cathodes and anodes are produced that can be layered together to produce the battery.

The decisions made at each manufacturing stage during electrode production will influence the set-up of subsequent processes and, ultimately, the overall battery performance. Engineers must carefully choose what combination of parameters should be used at each stage to deliver an optimal battery design. However, the volume of possible process parameters, as well as their interdependency, poses a significant challenge to battery manufacturers.

SIMULATING BATTERY DESIGN AND PERFORMANCE

Simulation offers battery manufacturers a predictive environment, where choices of battery production parameters can be linked to battery performance analysis. Dassault Systèmes software tools—such as Materials Studio and Abaqus—provide engineers with the opportunity to

1 https://innovateuk.blog.gov.uk/2017/12/11/the-challenge-of-creating-a-uk-vehicle-battery-industry/

2 https://www.weforum.org/agenda/2017/11/battery-batteries-electric-cars-carbon-sustainable-power-energy/

explore the design of electrode materials at the atomic level and to understand the macro-scale performance of entire cell.

EDEM, a SIMULIA Alliance Partner, is the market leader in bulk material simulation. EDEM software accurately reproduces the complex and dynamic behaviors of bulk and granular materials such as dirt, soil and powders during handling and processing operations. EDEM is used in a wide range of industry sectors including construction, pharmaceutical, mining and agriculture sectors.

In the case of battery manufacture, EDEM has applications in the electrode manufacturing process and battery performance analysis, providing engineers with an understanding of powder and micro-structure behaviors as electrodes are analysis, providing engineers with an understanding of powder and micro-structure behaviors as electrodes are formed and operated.

SIMULATING THE BATTERIES OF THE FUTURE

In 2016 EDEM launched the EDEM-Abaqus coupling. This innovation addressed a need that was seen in many industries to bring detailed data describing forces and pressures caused by the interaction of bulk materials on equipment and product structures. Engineers can now export realistic bulk material force data from EDEM into Abaqus FE simulations—leading to improved design accuracy and reduction of prototyping costs.

While this capability is most regularly used in 'Heavy Equipment' applications, following the Science in the Age of Experience Conference, EDEM and SIMULIA teams identified that the insight EDEM brings to battery simulation complements the solutions offered by SIMULIA. Both teams have now embarked on an R&D collaboration to understand how the EDEM-Abaqus coupling can be advanced to enhance predictions of battery performance.

The targeted EDEM-Abaqus solution is being developed jointly and will strengthen the link between production process parameters, materials selection, and the final performance of the battery. For battery manufacturers, this means even more investigations can be performed in the virtual environment, a reduction in the dependency on physical testing, and ultimately help them deliver the battery technologies of the future.

If you are interested in knowing more about EDEM simulation in the battery sector and this R&D initiative, please contact david.curry@edemsimulation.com

For More Information

www.edemsimulation.com