get it right®

BATTERY DESIGN AND DEVELOPMENT

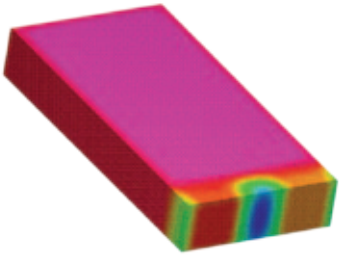
WITH ACE+ SUITE

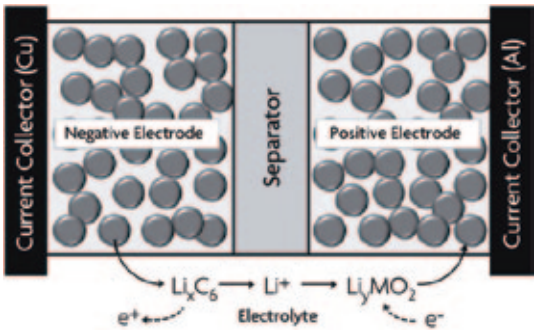
KEY BENEFITS

- Derive optimal form factor and cell size without prototypes.
- Maximize available current by optimizing connection points.
- Evaluate non-measurable internal parameters and correlate with measurable values.
- Minimize need for expensive and energy-consuming external cooling.
- Ensure maximum safety by studying thermal and electrical paths during misuse, damage, or overcharge events.
- Reduce weight and structural requirements by minimizing thermal-induced stresses during design process.

Batteries are complex devices with many competing factors determining performance and life. Simulation can be used to manage the competing phenomena and is extremely valuable for fine tuning the designs to achieve optimal performance.

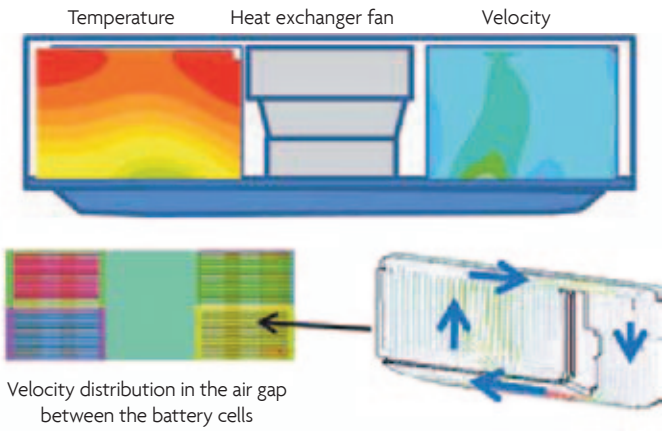
Critical factors for simulation include the ability to manage the large range of materials that are used in modern batteries. A flexible modeling architecture and an efficient database are essential to study the impact of a variety of materials on varying performance parameters such as heat generation, power, charging and discharge duration, as well as battery impedance.



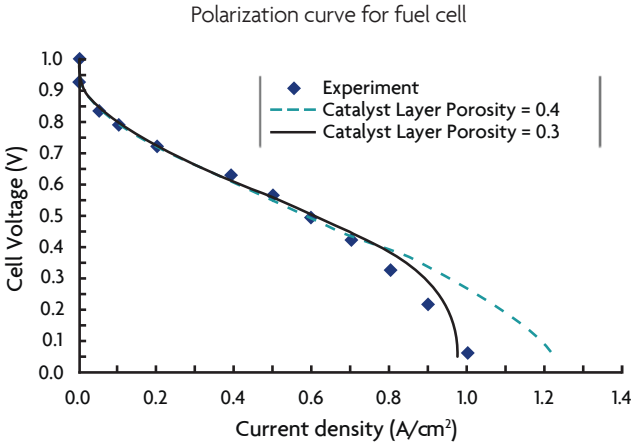


CHALLENGING MULTIPHYSICS

To properly simulate the multiphysics behavior of a battery, the user must include the electrophysics and chemistry occurring in multiphase electrodes. Both the solid and fluid electric potentials must be accounted for, as well as the ion diffusion through both phases. In many cases 1D models can be used to assess the electrochemical behavior of the battery, however 3D models are needed to determine the heating up of battery packs. Each modeling scheme has its merits and is required in designing the battery, its cooling system and eventually the electromagnetic shielding of the electronic components related to the power system.



Hybrid battery cooling system simulation

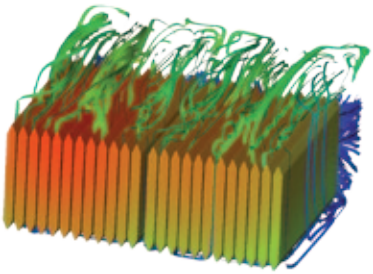


ACE+ Suite multiphysics electrochemistry validation

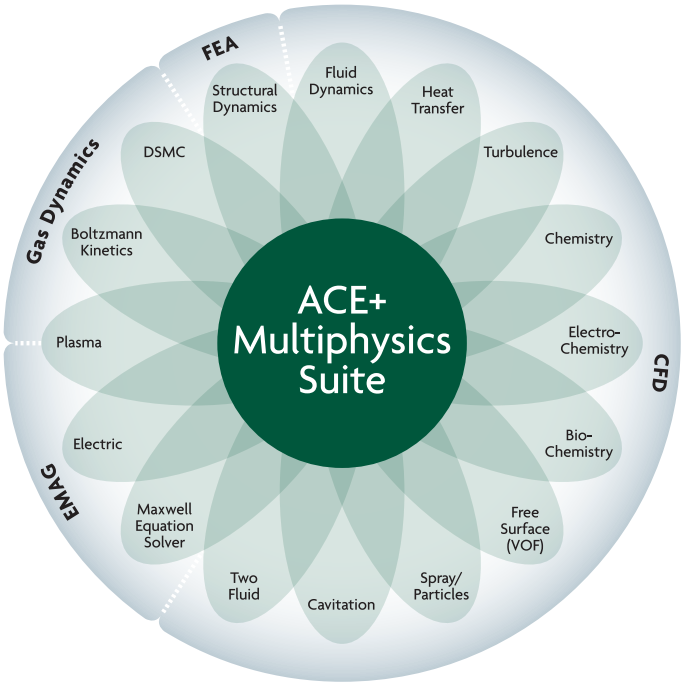
BATTERY COOLING

Many battery applications also have cooling issues, particularly in high power applications or under fast charge conditions. Water, air, or hybrid cooling package designs for removing the heat from battery packs need to be integrated into the final product design.

This example shows an air flow structure designed to cool the battery cells with minimum air pressure drop, cell to cell temperature variation, and lowest maximum temperature.



Li-Ion plate battery package with integrated cooling



For a given state of charge and reference potential, ACE+ Suite can predict the current, potential and temperature profiles in the battery under steady state operation. Development is underway to include a state-of-charge model as well as a transient solution for charge/discharge simulations. The simulation environment also includes a structural analysis module, as well as strong multiphysics capability.

The ACE+ Suite of multiphysics software for the virtual prototyping of batteries is the only solution with all the required physics and functionality available to study battery designs in detail. Built on advanced work in fuel cell development and semiconductor manufacturing, the battery capability available from ESI can help you move your battery development from the laboratory to simulation, giving your team the insight to bring the next critical innovation to market faster.

To find out more about ESI's ACE+ Suite, please visit: www.esi-group.com/ace+suite

ABOUT ESI GROUP

ESI is a pioneer and world-leading provider in virtual prototyping for manufacturing industries that takes into account the physics of materials. ESI has developed an extensive suite of coherent, industry-oriented applications to realistically simulate a product's behavior during testing, to fine-tune manufacturing processes in accordance with desired product performance, and to evaluate the environment's impact on performance. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping, thus eliminating the need for physical prototypes during product development. The company employs about 850 high-level specialists worldwide covering more than 30 countries. ESI Group is listed in compartment C of NYSE Euronext Paris. For further information, visit www.esi-group.com.

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