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MEASUREMENT DATA FOR CUSTOMER SIMULATIONS

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Lithium-ion cells and future battery systems can only be operated safely and with maximum service life within a narrow temperature range. In vehicles and power tools, significantly larger cells are deployed than in mobile electronic devices. Incorrectly positioned temperature sensors, or a cooling system which is not adjusted to the thermal parameters of the cells, can lead to local overheating. A large temperature gradient should also be avoided, because heated areas have a lower internal resistance: they are consequently more intensely loaded, and age faster. The most realistic material parameters possible are therefore needed for the concrete design of the cooling system or the simulation of the thermal behavior.

Development of a measurement method for thermal parameters

As the cell coil - the core component of a cell - is a complex combination of different solids (cathode, anode and the separator) and a liquid electrolyte, its inhomogeneous properties also make it difficult to measure the thermal parameters. The thermal conductivity parallel to the conductor foils is many times higher than the thermal conductivity perpendicular to the electrode layers. For realistic measurements, the samples are prepared within a protective atmosphere and impregnated with electrolyte. This allows the temperature and the contact pressure to be adjusted to the operating conditions and customer requirements.

Through public projects and collaborations with industry we have gained comprehensive practical experience in the measurement of important physical indicators.

- Thermal conductivity parallel to the electrode layers
- Thermal conductivity perpendicular to the electrode layers
- Thermal conductivity of different battery components (cathode, anode and separator)
- Thermal capacity
- Heat transfer coefficients from the cell coil to the cell casing
- Thermal resistivity from the cell coil to the terminal
- Heat conversion measurements

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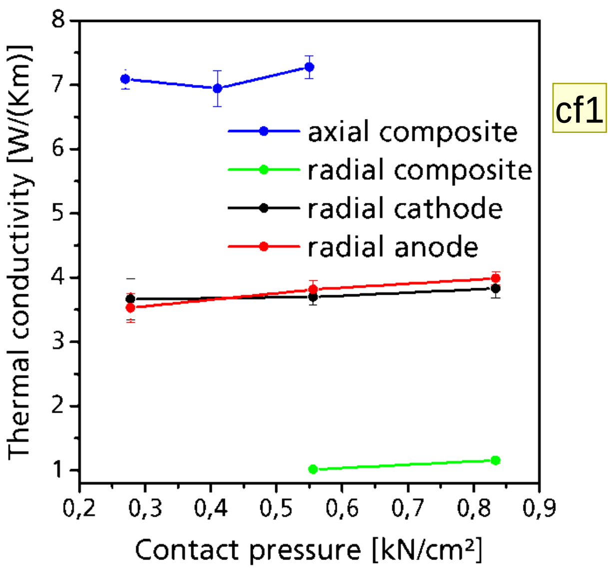
The measurement methods developed at ICT can therefore be adapted easily to super-capacitors, lithium-ion cells and other electrochemical energy converters of various designs.

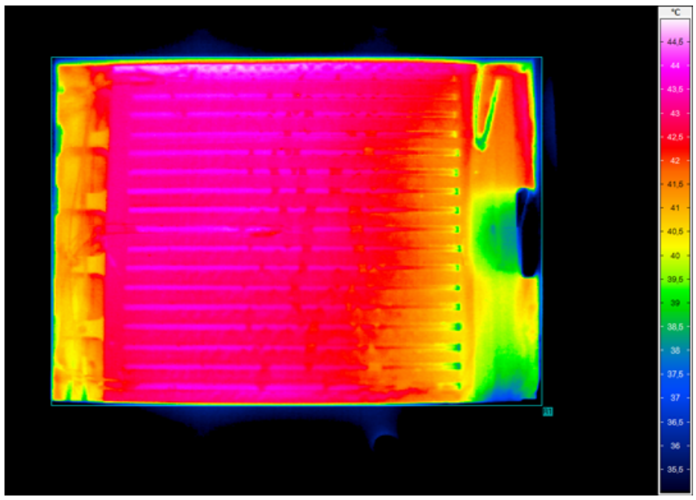
- Prismatic cells
- Cylindrical cells
- Pouch cells



Thermal conductivity of cylindrical hybrid super-capacitors in axial and radial direction from the composite (cathode/ separator/ anode), and the radial conductivity of cathodes and anodes

Verification measurements and internal temperature sensors

To test particularly critical elements of a simulation or the design of a cooling system we have developed verification measurement methods. The reproduction of a cooling system in the laboratory, the application of additional temperature sensors and thermographic imaging provide the opportunity to analyze specific applications more accurately, and compare them to simulation results. In addition, the internal temperature distribution can be examined by integrating internal temperature sensors.



Thermograph of an air-cooled pouch cell for the verification of thermal simulations