

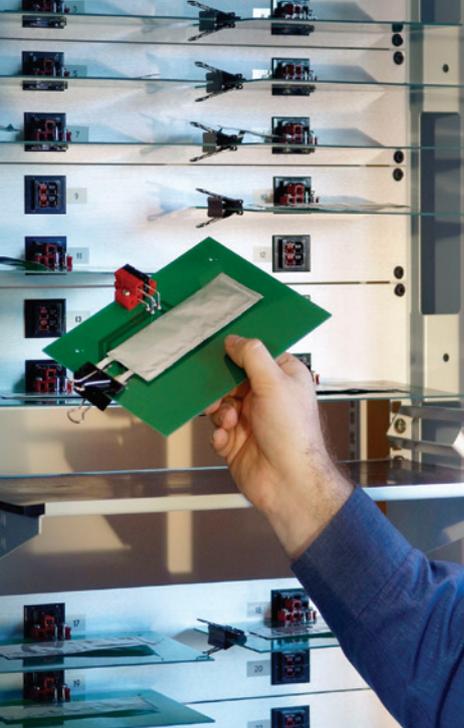


Fraunhofer
ISIT

Electrochemical Energy Storage Devices

Customized Lithium Secondary Cells
for demanding Applications





Instrumentation for electrical characterization of LiPo-test cells



Contacting- and feed-through area of a pouch cell



Head of roll to roll coater

Customized Lithium Secondary Cells for demanding Applications

Storage systems for electrical energy, ubiquitous in applications, will play a crucial role in the reorganization of the global energy sector for generations to come.

The current state of technology is the lithium ion cell available in different shapes and sizes. The present electrochemical storage solutions are yet regarded as dissatisfying concerning several important specifications (e.g. energy density, low temperature behaviour, economic feasibility).

Great efforts are made worldwide to reduce or even overcome these deficiencies by optimizing the present systems or by developing electrochemical cells applying novel material combinations like Lithium-Sulfur. Transferring novel energy storage concepts to industrial production represents both a great technological and an economic challenge.

The group „Battery Systems for Special Applications“ of Fraunhofer ISIT has been working in the field of electrochemical energy accumulators since 1999 and addresses central subjects with its two areas of expertise:

- The complete process chain for producing Lithium secondary cells with patented variable chemistry and design technologies. This includes the transfer and up-scaling of laboratory processes to industrial standard
- Test and characterization of cells and batteries.

Accumulator development

One of the main working fields of the group „Battery Systems for Special Applications“ is the further development of existing accumulator systems as well as research and adaptation of novel concepts.

The focus is on:

- new materials or material formulations for electrodes and new electrolyte systems and separators
- application optimized cell design
- further developed manufacturing processes

Increasing cell performance, reducing costs and improving the environmental performance of lithium batteries are our overarching goals.

Beyond that, activities are also guided by the need to customize lithium cells for different fields of application. In particular, this refers to

LiPo
Accumulators
flexible in shape
high performance
sustainable

optimization of parameters as energy density, power density, cycle stability, long life-time, intrinsic safety as well as the adaption for special conditions of operation. The "pouch-cells" developed by the ISIT enable flexibility of design in terms of size and shape to match exactly the space requirements for the cells and cell modules.

The possibility to design the cells flexibly with regard to cell chemistry, materials used, cell capacity and geometric dimensions is a unique selling point of the ISIT.

Cell manufacturing

Based on lithium polymer technology, Fraunhofer ISIT provides a flexible manufacturing platform enabling technical realisation of accumulator development. The production of cells can be divided in two main steps:

- Manufacturing of electrodes and separators
- Assembling of cells

A highlight of the cell manufacturing is the separator technology developed by the ISIT. This patented separator is exactly matched to the assembling process (lamination) for the production of Li-Ion-cells. By variation of materials in the lithium accumulator its performance can be controlled within a wide range.

In addition, the pouch casing enables an adaption of the cell design in a wide format range to predetermined dimensions. By continuous introduction of new materials a considerable „electrochemical system module“ could be generated over the last years. It is adjusted continuously to increasing requirements.

Testing of accumulators

The metrological facilities of the department offer possibilities for an extensive electrochemical and physical characterization of materials and cells. Material data like specific capacity, impedance, power density, lithiation- and delithiation potentials as well as any occurrence of outgassing rate can be examined in half-cells with 2- or 3-electrode arrangement against lithium.

Further important parameters like cycle stability, impedance and long term stability for a comprehensive understanding of the

electrochemical processes can be determined for half- and full cells in a wide temperature range (-40 ° to + 180 °C). On this, numerous test circuits with maximum currents from 100 mA to 100 A are available.

A special offer is also the characterization of cells by means of »cell-integrated sensor technology« (reference electrode, temperature sensor technology, expansion measurement).

Coating line and low volume production

Equipment and expertise of the group provide the possibility of scaling up the R&D results to industrial production standard. All sub-steps of production of electrochemical cells are included into the ISIT standard process.

Within the process chain for manufacturing lithiumionbatteries both sub-steps of slurry preparation and coating are particularly critical because slight parameter variations could cause a strong impact on the accumulator quality.

This goal is also served by the »Research Center for Applied Battery Technology Schleswig-Holstein - FAB-SH« currently being established at ISIT, which allows the processes systematically developed in R&D to be scaled up and optimized for series production.

Upscaling and optimizing of results from systematically developed research processes are possible by several mixer units, a coating line and prototyping facilities. Manufacturing capacities assure a rapid implementation of research results to low-volume production so that this process knowledge is also available for industrial partners.

Module Development

Development and assembling of energy storage systems (module integration, power electronics, BMS etc.) starting with single cells can be realized in cooperation with university research institutions and with industrial partners.

Above: LiPo-cells for electric automotive application in fixation/cooling images of a battery module

Bottom: 1 kWh battery module in autonomous operating vehicles for deep sea exploration



Development of lithium accumulators (cell design, process technologies, components) for demanding applications

Portfolio

Material/ Component Test

- Half-cell setup
- Full-cell setup

Cell development

- Electrode formulations
- Cell adaptation to field applications

Process development

- Separator technology
- Dry coating
- Cell manufacturing/Fab-SH
- Rapid prototyping
- Manufacturing of high-performance cells
- High temperature batteries

Battery systems / tests

- Cells with integrated sensors
- Cell analytics
- System development

Equipment

- Complete laboratory line for manufacturing format-flexible lithium accumulators
- Electrochemical and physical instrumentation for short-term and long-term characterization of components and cells
- Coating line for role to role processes

Service offers

- Development of customized lithium secondary cells
- Process development with upscaling towards industrial series production
- Prototyping and small volume manufacturing
- Qualifying and characterization of cells due to customers requirements
- Failure defective analysis
- Optimization and/or development of analytical methods
- Consulting service and technical studies
- Workshops and trainings



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Cooperations

