



STORAGE RESEARCH INFRASTRUCTURE ECO-SYSTEM

RI Information sheet 2022

KIT, FromMATtoBATT

Electrochemical ES (from material to battery)

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Project Acronym	StoRIES
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Project Start Date	01-11-2021
Project End Date	31-10-2025
Duration	48 months

1. Photo (of building, equipment, etc.)



Figure 1 KIT-HIU main building



Figure 2 Assembling of large-format pouch cells in the dry-room at the Battery Technology Center at KIT.



Figure 3 Cell testing lab at KIT.

2. Geographical coordinates (°, ′, ... N/S, E/W)

KIT HIU: 48° 25' 34.644" N, 9° 57' 36.036" E

KIT IAM-ESS: 49° 5' 30.192" N, 8° 25' 42.636" E



3. Description of the research infrastructure for the webpage

The electrochemical energy storage activities at KIT are primarily performed at the Institute of Applied Materials – Energy Storage Systems (IAM-ESS) and the Helmholtz Institute Ulm (HIU). The infrastructure is rounded off by the Battery Technology Center, an interdisciplinary scientific platform at KIT that also provides a research factory for production of differently sized battery cells and a large test field for electrochemical testing. The research facilities offer excellent experience in battery research, including battery active (electrode, liquid and solid electrolytes) and inactive (conductive additives, current collectors and binders) materials, as well as cell components such as cathodes and anodes. Assembly of cells is established from lab-scale to small coin cells (partially automated) or big industry-relevant pouch cells. They offer multi-purpose lab-scale plant for the characterisation of battery materials and lab-scale cells equipped with a large suite of mechanical, thermal, electrical, and other physical characterization and test equipment for ex-situ and in-situ examination of battery materials and cells. The available infrastructure allows comprehensive studies at each level of battery preparation, starting from search for the best battery chemistries for electrodes and electrolytes through assembling all battery components together into a cell, and, at the end, scaling up and fabrication of large-format pouch cells with >20 Ah capacity. A cell testing infrastructure with a large number of test channels (providing currents of 3A, 50A, 200A) allows electrical cell characterization including long-term tests and application-oriented assessments for the determination of cell performance of cells of any format. Furthermore, climatic chambers and safety housings permit measurements under specific conditions and safety-critical testing.

Web site address:

- KIT HIU: <http://www.hiu-batteries.de/battery-research-center-in-germany/>
- KIT IAM-ESS: <http://www.batterietechnikum.kit.edu/english/index.php#>

Services currently offered by the HIU infrastructure:

Dry-room laboratory (Dew point: -70°C) and several dry-boxes for water-free and air-free material handling and testing. Several laboratories for material synthesis, characterization and testing in electrochemical devices.

Platform for Accelerated Chemical Energy Storage Research (PLACES/R)

- Combinatorial synthesis of electrodes and formulation of liquid electrolytes
- High-throughput three-electrode half-cell electrochemistry
- Automated coin and pouch cell assembly with 192 channels
- High-throughput Raman (ambient and N₂), FTIR (ambient and N₂) and XRF (vacuum) Spectroscopy
- Near-ambient pressure XPS (Specs enviro ESCA)
- flow cell pulsed broadband NMR (Oxford x-pulse)

- Ambient air electrode coaters, clandering machine, cutting tools and decrimpers for manual experiments, 30t large hydraulic press
- Data communication using management exceeding FAIR standards requirements and capabilities for autonomous orchestration of synthesis and characterization.

BIG MAP - Active and inactive battery materials: Synthesis and characterization

- A few labs for the synthesis of inorganic and organic compounds
- Ovens and mufflers for high-temperature material processing

Electrodes and inactive components processing:

- Lab-scale electrode/hybrid solid electrolyte coaters and drying ovens
- Automatic electrode/hybrid solid electrolyte coaters

A non-exhaustive list of equipment dedicated to the above-mentioned services, includes:

- A few hundreds battery cycler channels
- Impedance analyser and potentiostats/galvanostats
- Multichannel conductivity meters
- BET, Pycnometer, densitometer
- TGA/MS, DSC, FTIR Raman, XRD, Karl-Fischer
- Microwave Reactor, Muffle furnaces, Planetary Ball Mill, Supercritical fluids extractor
- Tube furnaces
- Ultrasonic Processors
- Supercritical extractors
- Hot Press and UV Chamber for polymer processing, including cross-linking
- Light and electron microscopies
- HPLC and GC measurements of electrolyte constituents
- SEM equipped with FIB
- X-ray analysis, XPS, SAXS-WAXS
- ...

Services currently offered by the IAM-ESS infrastructure:

Cell Assembly: By use of a semi-automatic line for manual manufacture of pouch cells in a dry room.

- Analysis of failure mechanisms with forced cell failures
- Performance analysis of cell components, such as separator, electrodes, conductor foils
- Tests of new electrolytes and additives
- Tests of new active materials
- Tests of new cell formats

Cell Tests: Electrochemical characterization of cells of any format (hard case, pouch and round cells).

- Rate capability and internal resistance
- Endurance tests and application of load profiles
- Calendar aging tests

- Electrochemical impedance spectroscopy

Post-mortem Analysis: Investigation of aging phenomena or cause and effect relationships.

- Light and electron microscopy
- HPLC and GC measurements of electrolyte constituents

A non-exhaustive list of equipment dedicated to the above-mentioned services includes:

- A few hundreds battery cycler channels
- Impedance analyser and potentiostats/galvanostats
- SEM, XRD, XPS, ToF-SIMS
- NMR
- BET, TGA/MS, DSC, FTIR Raman, XRD, Karl-Fischer
- Muffle furnaces, Tube furnaces, Planetary Ball Mill,
- Electrode coater
- Light and electron microscopies
- HPLC and GC measurements of electrolyte constituents

4. Availability of the research infrastructure

(Please indicate time periods in which infrastructure will not be available for StoRIES in the next 2 years – if already known)

The facilities at HIU are immediately available. However, a limit of two visitors within the same call is foreseen. In the laboratories of the Stein group there is also the possibility to remote control some of the research instruments immediately.

5. Special considerations (confidentiality / NDA agreements, insurance requirement, special training, HSE training)

HIU will host TNA access users after the signing of a confidentiality/NDA agreement. Users will receive the mandatory safety training as well as a dedicated training to access specific laboratories and equipment.

6. Energy storage technology that can be analysed/studied by using the research infrastructure

- Electrochemical
- Chemical
- Thermal
- Mechanical
- Superconducting Magnetic

- Cross-cutting (Specifically: ...)

7. Key words for the webpage

Battery, cathode, anode, electrode, electrolyte, MAP, ...

8. TRL level (if applicable):

- 1-3 (at HIU)
- 4-6
- Above

