Cutting-edge Electrochemical Energy Storage





Helmholtz Institute Ulm (HIU) Electrochemical Energy Storage











Facts & Figures

Name

Helmholtz Institute Ulm (HIU) Electrochemical Energy Storage

Founded 2011

Director

Prof. Dr. Maximilian Fichtner

Board of Directors

Prof. Dr. Stefano Passerini (Deputy Director), Prof. Dr. Joachim Ankerhold, Prof. Oliver Kraft, Prof. Dr. Arnulf Latz, Dr. Margret Wohlfahrt-Mehrens

Managing Director

Dr. Dagmar Oertel

Postal Address

Helmholtzstraße 11, 89081 Ulm

Staff

Total: ca. 115 (August 2015)

- Principle Investigators: 23

- Scientists: 47

- Ph.D Candidates: 37 - Administration: 8

- Professors: 3

- Staff in Karlsruhe: 22

Partners

- Karlsruhe Institute of Technology (KIT)
- University of Ulm
- Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW)
- German Aerospace Center (DLR)



About Us

The Helmholtz Institute UIm (HIU) is dedicated to the study and development of the next and subsequent generations of electrochemical energy storage devices. Efficient batteries are the most important key to the success of the energy transformation – the Energiewende – and of electromobility. At HIU, an international team of approximately 115 scientists is conducting research to further develop the foundations for sustainable energy storage for both stationary and mobile use.

HIU was founded in January 2011 by the Karlsruhe Institute of Technology (KIT). As a member of the Helmholtz Association, KIT initiated the new institution in collaboration with the University of Ulm and involved two strong associated partners, the German Aerospace Center (DLR) and the Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW).

By efficiently bringing together the unique expertise of each of these four partners, HIU will make it possible in the medium or long term to achieve far-reaching progress in research into energy storage. Through the integration of basic and applied research under one roof, HIU has the ability to make a significant contribution to a socially relevant problem by guaranteeing the future use of energy from renewable sources.



Aims & Strategies

Aims

Energy from intermittent renewable resources such as wind and sunlight needs to be buffered because it is not always available for immediate use. Similarly, electric cars must store the electrical energy required for driving. An efficient solution to this problem is the use of batteries that can temporarily store and release electrical energy with very little loss.

HIU addresses the basic issues of electrochemical storage and, on the basis of new knowledge, develops fundamentally new materials and cell concepts.

The primary aim of HIU is to develop sustainable electrochemical energy storage that has higher capacity and greater efficiency while also being lighter, longer lasting, safer, and cheaper than the technologies currently available. This should constitute a significant contribution to the storage of energy provided by fluctuating renewable energy sources and for electromobility.

Strategies

To reach these aims, HIU combines knowledge from four leading research organizations under one roof. Unlike any other research institute in Germany, it – together with the expertise of its partners – covers virtually every aspect of battery research.

In this context, HIU strives to integrate excellent basic research with applied work. At the same time, it provides the opportunities for highly qualified young scientists, to work in this field of strategic importance to research and the economy.

Organization

The Helmholtz Institute Ulm is part of the Helmholtz Association, Germany's largest scientific organization. The Karlsruhe Institute of Technology (KIT) is the founder and the organization directly responsible for HIU. KIT started HIU in cooperation with the University of Ulm. They were then joined by two other strong associated partners, the German Aerospace Center (DLR) and the Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW). Researchers from the four partner institutions gather at HIU to combine their expertise in research on electrochemical energy storage.

HIU's unique structure is also reflected in its Board of Directors, which consists of a member from each partner. As the highest governing body of HIU, it meets regularly, makes all strategic decisions, and is responsible for external relations and the assessment of the Institute's efficacy.

A further important body is the Advisory Board, whose task is to advise the Board of Directors on questions pertaining to strategy and the direction of research.

Research at HIU is organized into five areas (electrochemistry, materials, theory, systems, and methods), which in turn are divided into various research groups. These are led by renowned scientists who also head institutes or research groups at one of the four partner institutions. HIU has also defined four interdisciplinary topics – metal deposition, insertion materials and electrode structure, lithium-based conversion materials, and batteries beyond lithium – which are the object of intergroup research. A Helmholtz Young Investigators Group has also been working on topics related to electrochemistry since 2012.

Research

The lithium-ion battery is currently the most important type of battery among high-performance rechargeable batteries. While small lithium-ion batteries are already being used commercially in consumer electronics, electrical tools, hybrid vehicles, and electric cars, the commercial use of larger energy storage units is still in its early stages. The maximum storage capacity of conventional lithium-ion batteries has, however, nearly been reached. In order to achieve advances in performance, it is necessary to spur the development of new storage concepts.

To achieve another significant jump in the energy density of battery cells, new storage materials and new ideas for more compact cell designs are needed. The scientists at HIU conduct basic research, not only to further optimize lithium-ion batteries, but also to develop entirely new types of batteries, which they hope may one day lead to more advanced innovations

For this purpose, experimentalists and theorists work closely together at HIU to achieve improvements in the development of materials as well as in battery architecture. In HIU's laboratories, battery cells made of different combinations of materials are tested to precisely determin their energy density, lifespan, and performance. The smallest details, such as the behavior of newly added elements. can have an enormous influence on the processes of battery charging and discharging. Processes taking place at the subatomic-, nano- or microlevel of a battery can be crucial. The goal is to study how elementary processes affect the functioning of electrochemical energy storage devices.

Furthermore the researchers at HIU attempt, to understand electrochemical effects by utilizing a combination of experimental measurements and multiscale simulations, in order to draw conclusions about real applications



Research Groups & Leaders

Research at HIU is organized in five research areas, which in turn are subdivided into 13 research groups.

Electrochemistry

Electrochemistry for Batteries Prof. Dr. S. Passerini

Basics of Electrochemistry Prof. Dr. T. Jacob

Interactions Electrode & Electrolyte Prof. Dr. R. J. Behm

Materials

Solid State Chemistry Prof. Dr. M. Fichtner

Composites / Hybrid Materials Dr. M. Wohlfahrt-Mehrens Prof. Dr. N. Hüsing

Nanomaterials and Nano-/Microstructures

Prof. Dr.-Ing. H. Hahn Prof. Dr. M. Fichtner

Prof. Dr. H. Ehrenberg, Dr. F. Scheiba

Theory

Multiscale Modeling

Prof. Dr. T. Jacob

Elementary Processes Prof. Dr. A. Groß

Electrochemical Multiphysics Modelling Prof. Dr. A. Latz

Systems

Battery-Management and Monitoring Prof. Dr. W. Tillmetz Dr.-Ing. M. Danzer

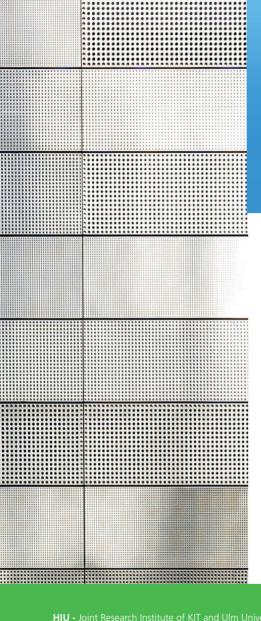
Resources, Recycling, Environment & Sustainability Prof. Dr. A. Grunwald Dr. M. Weil

Methods

Dr. H. Geßwein Dr. Ch. Kübel Prof. Dr. U. Kaiser Dr. R. Mönig Dr. M. Knapp Dr. S. Indris

Helmholtz Young Investigator Group

Dr. R. Zeis



Legal Notice:
Helmholtz Institute Ulm (HIU)
Electrochemical Energy Storage
Helmholtzstraße 11
89081 Ulm
T +49 731 50 34001
F +49 731 50 34009
E info@hiu.kit.edu

www.hiu-batteries.de/en/

HIU - Joint Research Institute of KIT and Ulm University with Associated Partners DLR and ZSW

KIT - The Research University in the Helmholtz Association



Photo Credits

- p.1 © Werner Huthmacher
- p.2 © DLR
- p.3 © Rosa-Maria Grass/ HIU
- p.4 © Elvira Eberhardt/ HIU
- p.7 © Elvira Eberhardt/ HIU
- p.8 © Elvira Eberhardt/ HIU

Date: January 2016