EPE'22 ECCE Europe – Call for Tutorials

Understanding Lithium-Ion Batteries as a Partner of Power Electronics

Name(s) and Affiliation(s) of the Lecturer(s):

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Tutorial Objectives:

The objective of tutorial to present

- how lithium-ion batteries work, state of the art and future trends
- what performance you can expect from different products and chemistry, ageing processes and relation to the operating conditions
- how to assess the safety, model, and condition monitoring of lithium-ion batteries using impedance spectroscopy
- What are the mutual impacts between batteries and power electronics

Target Audience:

The target audience of the tutorial is anyone for whom plays a role in battery production, system development and applications. In particular, it aims to provide the knowledge necessary for developers of power electronics used together with batteries to understand the battery.
The tutorial will benefit anyone who,

- develop power electronics for battery systems,
- develop products and applications with battery systems considering market development
- fundamentally want to better understand how batteries work and what performance and characteristics are achieved today

Topical Outline:

Introduction: (Estimated time: 30 minutes)

- Introduction of speaker, their background and activities of the host institution
- Introduction of the participants to understand their background and their expectations
- Introduction to the seminar program and, it of interest, discussion of additional focus topics

Introduction of Lithium-Ion Battery Technology and its Production (Estimated time: 60 minutes)

- General classification of lithium-based batteries and performance characteristics
- General design, thermodynamics, and kinetics of lithium-ion batteries
- General overview of the manufacturing processes, availability of raw materials, development of markets

Performance, Safety, and Lifetime of Lithium-ion Battery Technology (Estimated time: 90 minutes)

- Safety issues of lithium-ion batteries: origins, BMS, and pack level safety considerations
- Charging and discharging performance of lithium-ion batteries: limits, degradation (lithium plating), and temperature dependent ageing
- Lifetime and reliability of lithium-ion batteries: Impact of cells' size and cells' interconnection

Impedance Spectroscopy for characterization and modeling of the dynamic behavior of lithium ion batteries (Estimated time: 90 minutes)

- Fundamentals of impedance spectroscopy (IS) on lithium-ion batteries
- Impedance-based modelling and diagnostics of lithium-ion batteries incl. parameterization
- Hardware aspects of IS in the lab and on commercial battery systems
- Applications of impedance spectroscopy in quality control and safety monitoring

System integration of batteries and power electronics (Estimated time: 90 minutes)

- Optimum voltage level: impact on the design and reliability of the battery system
- Impacts of converter's current ripple on lithium-ion batteries: frequency and amplitude
- Joint design of battery pack and power electronics to improve the quality of the package
- Function of charge balancing systems, balancing topologies, and BMS design

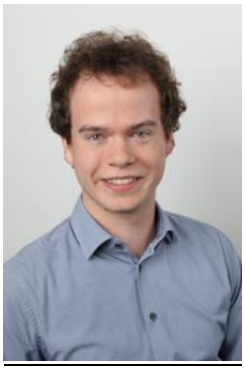
- Final discussion of summary of the tutorial and Q&A with the participants

Provisional Schedule of the Tutorial:

9:30 – 10:00 Introduction of speaker and the participants, presentation of the tutorial program
10:00 – 11:00 Introduction of Lithium-Ion Battery Technology and its Production
11:00 – 11:30 Coffee break
11:30 – 13:00 Performance, Safety, and Lifetime of Lithium-ion Battery Technology
13:00 – 14:00 Lunch break
14:00 – 15:30 Impedance Spectroscopy for characterization and modeling of the dynamic behavior of lithium ion batteries
15:30 – 16:00 Coffee break
16:00 – 17:30 System integration of batteries and power electronics

About the Lecturers:

Dirk Uwe Sauer if professor for Electrochemical Energy Conversion and Storage Systems at the Institute of Power Electronics and Electrical Drives (ISEA) at RWTH Aachen University since 19 years. He is a specialist for all aspects on system integration of batteries incl. testing, characterization, ageing, modeling, diagnostics, lifetime prediction and field integration into any type of mobile or stationary applications. His chair has about 75 full time employees and more than 60 students as student assistance, or in bachelor or master thesis. He is a member of the National Academy of Science and Engineering (acatech) and the Berlin-Brandenburg Academy of Sciences and Humanities (BBAW). He is also the co-founder of 4 spin-off companies.



Alexander Blömeke is an electrical engineer by training from RWTH Aachen University. He is working in the field of battery characterization, battery diagnostics and battery modelling with a special focus on impedance-based methods. Currently he is the chief engineer of the department "Battery System Design and Vehicle Integration" with about 25 scientists from different disciplines at the "Chair for Electrochemical Energy Conversion and Storage Systems" at the Institute of Power Electronics and Electrical Drives (ISEA) at RWTH Aachen University.

Hamzeh Beiranvand (Member, IEEE) is a postdoc at the chair of Power Electronics, Kiel University, Germany and leading the battery group. He has a PhD degree in Power Electronics on the design optimization and control of Solid-State Transformers (SST). In 2021, he has been elected as a member of Kiel Nano, Surface and Interface Science (KiNSIS). He has published more than 40 conference and journal papers during his research profession. His main interests are Lithium ion batteries and interaction between batteries and power electronics converters.

Andreas Würsig is head of the "Research Center for Applied Battery Technology" at the Fraunhofer Institute for Silicon Technology (ISIT). For more than 20 years he has been working on the development of advanced battery technologies, especially in the areas of cell manufacturing, system integration and characterization. Since 2006, he has been involved in the development of customized lithium battery cells and their adaptation to a wide range of applications at the Fraunhofer Institute ISIT. He holds 2 patents and has published more than 20 papers.