

# 8<sup>th</sup> Developer Forum Battery Technologies

*E-Mobility and mobile Internet fuel future battery market*

*Batteryuniversity GmbH organized the 8<sup>th</sup> Entwicklerforum Akkutechnologien from 24<sup>th</sup> to 26<sup>th</sup> of March in the Stadthalle in Aschaffenburg. More than 600 attendees took the opportunity to get actual information about the battery market and newest developments in battery technology especially Li-Ion. 35 companies presented their solutions, innovations and visions about the future of batteries in the accompanying exhibition. This report highlights a short selection regarding innovations in battery power.*

*By Wolfgang Patelay, Freelance Journalist, Bodo's Power Systems*

After welcoming the attendees Sven Bauer, Geschäftsführer of batteryuniversity, gave an insight in the international battery market. According to his knowledge the international market for rechargeable batteries of all technologies including Li-Ion will grow with an average growth rate of 12% from 25,000 MWh in 2010 to 160,000 MWh in 2025, whereat Li-Ion in the 18650 format will be by far the most used technology. In Europe there are two main markets for rechargeable battery – stationary energy storage for renewable energy and e-mobility. For 2015 Bauer expects a demand for 100,000,000 battery cells per year with a potential 100% growth rate in this market. Electric vehicles are divided into e-bikes, e-scooters, and e-vehicles (EVs) like cars, forklifts, etc. Due to the pressure to reduce CO<sub>2</sub> emissions Bauer sees a potential for 50,000,000 battery cells only for electric vehicles for the “last mile” in Germany. Deutsche Post has approx. 90,000 vehicles in use for long distance traffic, regional transport and service for the last mile. To electrify these vehicles results in a huge growths potential for rechargeable batteries. The private sector is to date hesitant yet to use EVs. In the period between January 2014 and May 2014 there were 4,432 EVs registered in Germany and 40,639 EVs in the USA (source: Kraftfahrtbundesamt). But the public authorities in both countries try to push the future use of EVs what in turn results in growth potential for rechargeable batteries. Due to the promotion of EVs it is expected, that the international market will grow in the main markets up to 6,000,000 EV units in 2020. At the same time it is expected that the price for large 3rd generation Li-Ion batteries (LIBs) will decrease from 1000 Euro/kWh to approx. 200 Euro/kWh and will also fuel the LIB market. Actual predictions assume a price decline of 80% until 2030. Bauer concluded his presentation with new research activities regarding Adaptive City Mobility (ACM), the smart grid, and emerging new Li-Ion chemistries which will also fuel further the market for rechargeable batteries.

Christian Gerspacher from batteryuniversity illustrates in his presentation “criteria for selecting battery cells” the advantages of Li-Ion technology e.g. high cell voltages, no memory und no lazy effect, high energy density, high efficiency up to 95%, wide operating temperature range from – 20 °C to + 70 °C, longevity up to 300 cycles, small self discharge, and environmental friendliness. He discussed the various anode and cathode materials which creates in different combinations the wanted characteristics of the final battery cell. He also introduced a chart which simplifies the selection of the cell chemistry and cell fea-



Figure 1: The Conference ( image: Werner W. Wiesmeier)

tures as well as a program developed by batteryuniversity to compare individual battery cells and simplify the selection of suited battery cells.

## Fuses protect Li-Ion batteries

In his presentation “Self Control Protector (SCP) - Surface mounted type fuse for Li-Ion rechargeable battery” Eelco Schottert from Dexerials described this fuse in detail which has been shipped over 1.3 billion units since its launch in 1993 the beginning of the Li-Ion battery commercialization. The small, thin and surface mountable device protects the batteries from overcurrent and overvoltage. After the explanation how this fuse works he gave same application examples starting with Smartphones, Tablet PCs, and Notebooks up to power tools, garden tools, E-bikes, E-scooters and energy storage systems (ESS). Then he gave an overview about the 21 types of fuses the company is offering today. The small SFH series (5.4x3.2x1.25mm) and the even smaller SFJ series (4.0x3.0x0.85mm) are rated for 12A and 15A respectively and suited for a multitude of mobile applications. The high rated (up to 30A) SFK series is available at the moment for power tools and ESS. The technology roadmap includes even smaller and thinner variants in the SFR series as well as up to 60A rated devices in the SFK series. Due to the trend to e-mobility the higher rated fuses will be extended with models up to 90A and more than 100A. Under development is also a specialized Protector only for overcur-

rent, the PSx series. Concluding his presentation he introduced a receiving coil for wireless charging which is capable for high receiving efficiency and flexibility, and maximizing the ability on design. The flexible 0.52mm to 0.75mm thick coil has over 70% receiving efficiency at 4W, shows consistent receiving capability for various Qi transmitters conforms to the RoHS directive and is Halogen free.

#### Wireless charging including data transmission

Wireless charging and data transmission was also the topic of Andreas Hagemeyers, Friwo, presentation "Inductive charge and data transmission" which was created in cooperation with Universität Duisburg Essen. He explained the reasons for the inductive power transmission because there is no aging but in plug-in connectors. In addition enables the encapsulated housing the use in harsh industrial environments and even ex-proof areas. The plain surface enables easy cleaning and disinfection. And there is no wired connection necessary between charger and receiver. But there are also challenges. The first are the poor efficiency, EMC problems, and the sensitivity for foreign particles. This leads to complex circuit designs. After that he explained a newly developed 2 stage concept for inductive power transmission which is suited for 300W to 150W and allows the simultaneous transmission of data. He concluded his lecture with the description of a demonstrator and an outlook to realize the transmission of larger amounts of power.

#### Robust batteries for industrial use

Dr. Carsten Jähne from Tadiran Batteries, an Israelite manufacturer of Lithium batteries for industrial applications, introduced the rechargeable TLI-1550A batteries. It features a nominal voltage of 4V, a maximum capacity of 330 mAh, a maximum continuous discharge current of 2A, pulse peak current of 5A, maximum current voltage of 4.1V, and maximum charge current of 100mA (-20°C to +50°C) or 20mA (-40°C to +85°C). If the TLI-1550A cells are used in larger batteries containing multiple cells it is recommended to use a separate PCM (protection circuit module) for balancing the individual battery cells. After describing major characteristics of the battery e.g. cycle stability and aging he explained the main applications like eCall and SVT (stolen vehicle tracking). In these applications the battery has to show an average capacity of 5W and a peak capacity of 20W for 15 minutes after 5 years – in SVT even multiple times. He concluded his presentation with an outlook of the future roadmap.

#### Scalable battery management solution

"Scalable battery management platforms for rapid cost-optimized design" was the topic of the lecture by Doug Williams from Texas Instruments Battery Management Group. After introducing his business group he explained the typical intelligent battery architecture as well as the "incredible diverse" industrial applications for batteries. Because the variety of battery powered products requires different

batteries there is also a need for different pack sizes depending on various products. But the goal is to create a scalable BMS solution which fulfils most of the applications. Then he introduced the next-generation battery and monitor gauge bq76940 series, a scalable family which includes three different products for 10.8V to 18V, 24V to 36V packs, and 36V to 48V packs. This family is extended by the advanced CEDV fuel gauging companion battery manager bq78350 to enable complete battery management solutions. Another optional peripheral for the bq76940 family – the bq76200 - allows using high side power switches to realize even more flexible solutions. The description of typical applications concluded his presentation.

#### Gas sensors for battery monitoring

"Detection of failure modes and protection solutions for Li-Ion energy packs by means of gas sensors" was the topic of the lecture by Dr. Martin Herold from AMS. At the beginning he defined the motivation for using a gas sensor - added safety for small costs. Gas sensors are already used for monitoring battery charging station but are yet not used with Li-Ion-batteries. This new application offers new market opportunities by venting detection and leakage detection. The small sensor design can fit into existing battery packs and is easy to interface with BMS. After explaining the various principles of operation of gas sensors he introduced a portable battery management system with gas sensor. In this portable demonstrator pack the gas sensor is used for emergency shut-off. AMS performed all destructive and non-destructive tests for batteries like nail penetration, overcharging, short circuit, charging cycles, temperature cycling, and leakage and reported the results. The results demonstrated the suitability of the gas sensor to monitor battery packs:

- gas sensors are capable of increasing safety in large lithium-ion battery systems
- costs are comparably small
- gas venting from a cell under abuse is detected
- electrolyte leaks are detected
- user can be warned and an emergency shutdown performed to prevent further damage
- gas sensors might detect a rise in VOC concentration even before a bloated cell fully opens
- automated shut off may prevent cell venting
- the absolute value of the sensor signal is not always indicative and change in the resistance value should be taken into account.

#### Measurement technologies for energy consumption

Carlo Canziani, Business Development Manager of the Power and Energy Division of Keysight gave a lecture about a "real life battery use case & estimation of battery life". He started with the most common questions from battery users depending on the battery used in the individual device what results in the single question: "Can the energy consumption be optimized?" To illustrate how recent test and measurements innovations can help to measure and generate the corresponding measurement results he took the examples of drilling holes and tightening screws with a battery drill. He described the test challenge of measuring current accurately with oscilloscopes und DMMs and recommended a high performance power source / sink solution from ultra low power of some milliwatt to high power of several kW. After illustrating the innovations in this solution e.g. seamless current ranging, long term data logging and high integration of the source / sink solution, he explained an example measurement and introduced the entire test and measurement systems from his company to the audience.

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