Fraunhofer LBF

Powerful, robust, inexpensive

LI-ION BASED ENERGY STORAGE FOR ENERGY AND MASS-CRITICAL APPLICATIONS

Energy storage in electrically powered vehicles requires relatively large, heavy and very expensive systems. Despite advances in the active material of today's secondary cells, the energy storage systems built from them remain complex in terms of integration, cooling and battery management. Especially these last mentioned requirements were consequently considered in the project »Lasten-LeichtBauFahrrad« (L-LBF). Advanced solutions for energy- and mass-critical applications, for example in pedal-assisted bicycles or light vehicles, were developed.

Introduction

The storage of energy in electrically powered vehicles makes necessary relatively large, heavy and very expensive systems. Despite the advances in active materials of today's secondary cells, the energy storage systems built from them continue to be complex with regard to integration, cooling and battery management. These last-mentioned requirements in particular were consistently considered in this project, and advanced solutions for energy and mass-critical applications, for example in pedal-assisted bicycles or light vehicles, were developed.

Integration in the supporting structure

With the tubular energy system (TES), a Li-Ion-based energy storage system was developed for particularly energy and mass-critical applications, which clearly differentiates itself from today's storage systems through a series of innovative design features. Individual storage modules made up of 18650 round cells were fully integrated into the interior of a frame tube designed as a central support structure with a diameter of 80 millimeters. This means that all components of the housing that would otherwise be necessary, as well as the components for connection to the vehicle structure or for theft protection, can be dispensed with the complete integration of the energy store into the circular cylindrical pipe interior, excellent conditions are created for particularly effective air cooling through the inner pipe flow with a small cooler-fan combination.

High electrical safety thanks to the special design of the power connector

The power connectors situated and spot-welded on the top and bottom of the modules are made of diffusion-annealed steel with a specially-shaped electrolytic nickel coating. On the material side, this ensures low contact resistance and high corrosion resistance.

The special design ensures targeted flexibility in the axial direction for compatibility with possible deformations of the supporting structure and an overcurrent protection device.

Ultra-low-power monitoring of the batteries for long-term use and reliability

Often, depending on the season, pedal-assisted bicycles or light vehicles are not used for a longer period of time. In order to guarantee the desired reliability of the energy storage, the tubular energy system (TES) is equipped with a particularly energy-efficient storage monitoring system that continuously detects the charge and aging status of the modules with special ultra-low-power electronics and, if necessary, sends a request to recharge the battery directly to the driver's smartphone.

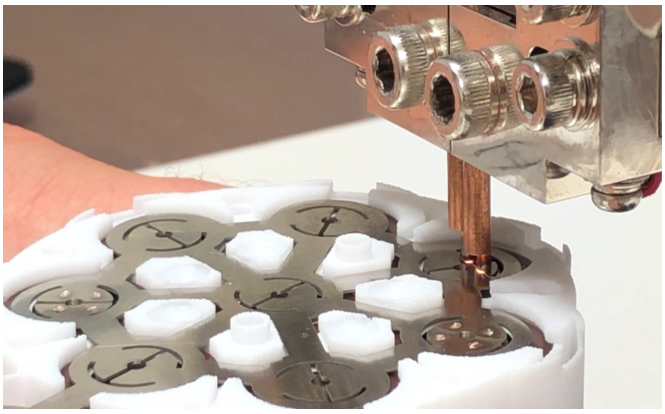
Resistance spot welding of Li-ion cells at Fraunhofer LBF

TES: The combination of reliability and value for money

Battery management, integration and cooling are the decisive quality features of an advanced energy storage system: With the TESTechnology, the researchers from the »System Reliability | Future Mobility« designed a system that offers significant advantages over conventional energy storage systems in terms of costs and scalability as well as security and reliability. The TES technology combines the cost advantages and robustness of cylindrical single cells with a particularly high degree of functional integration and energy efficiency. With the possible standardization of the tubular energy system (TES) with regard to its main dimensions, good prerequisites are created for finding a corresponding market potential even in very price-sensitive applications.

Other areas of application for TES technology

With the tubular energy system (TES) integrated into the supporting structure, an ultra-efficient energy storage system is available that was initially developed for the requirements of pedal-assisted bicycles or light vehicles: Such vehicles have little space for storage integration and, due to the possibly very discontinuous use a particularly energy-efficient storage monitoring. In principle, comparable boundary conditions can also be found in other modes of transport, such as trams on routes with interrupted overhead lines, smaller boats or gliders with electric drives. Furthermore, flexibly scalable storage clusters are also conceivable with the TES technology or within the individual tube storage systems constructed in uniform lengths and interconnected with one another. The flexibility that can be achieved with regard to storage size and maintainability as well as the particularly high level of security make TES technology interesting for industrial and domestic applications in connection with photovoltaics.



New power connector design

More information

www.lbf.fraunhofer.de/de/projekte/leichtbau-lastenfahrrad.html

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