

PRESS RELEASE

Worldwide First Battery System Employing High-Power Aluminum Ion Technology for Energy Storage

It's a milestone for lithium-free battery technology: for the first time ever, a complete battery system demonstrator based on aluminum-graphite-dual-ion batteries (AGDIB) has been realized. This proves the stability of the new battery cell chemistry not only in a laboratory environment, but also in a more realistic scenario. The rechargeable AGDIB battery cells are a safe low-cost energy storage technology and follow the design-for-recycling approach, making them a future-proof lithium alternative for high power applications like dynamic grid stabilization.

From cell to recycling: integrated value chain for an innovative battery system

The rising demand for electrical energy – driven, for example, by the need to store and balance renewable energy – calls for suitable storage solutions. The rechargeable aluminum-graphite-ion battery (AGDIB) meets this need with its low-cost and easily available active materials aluminum and graphite. As a high-power storage device, the AGDIB can be charged and discharged in a very short time at high rates. This makes the AGDIB ideal for applications such as dynamic grid stabilization, where batteries are used to balance frequency fluctuations with many low-energy micro cycles that favor high power performance over high energy density.

While many new Li-free battery technologies are examined on lab-size cell level, battery system demonstrators employing new cell chemistries remain rare. However, such a battery system demonstrator based on AGDIB has now been set up within the INNOBATT project after scaling the technology to small-size pouch cells in previous research projects first. The development of this innovative battery system focuses on the whole value chain, from a sustainable Li-free cell chemistry over integration of wireless battery management system (BMS) and bidirectional quantum-based current sensor technologies to recyclability considerations.

Demonstrator validates stability of new Al-ion battery cells

In a realistic test case, the INNOBATT demonstrator proves the stability of the new type battery cells. Integrating eight AGDIB pouch cells with a wireless BMS based on the open source BMS platform [foxBMS®](#) from Fraunhofer IISB with secure radio frequency based (RF) communication, the prototype also features a novel diamond-based quantum sensor for high-resolution current measurement.

AGDIB active materials and cell design were improved to increase stability and reliability of the cells and ensure reproducible performance metrics. This allowed for a proper cell matching despite the manual manufacturing technology. The battery module was assembled in 4s2p configuration, employing a BMS-Slave with a safe wireless RF communication to the BMS-Master. The quantum sensor is based on NV-centers

BMFTR-FUNDED PROJECT
Eine Batterie neu denken.

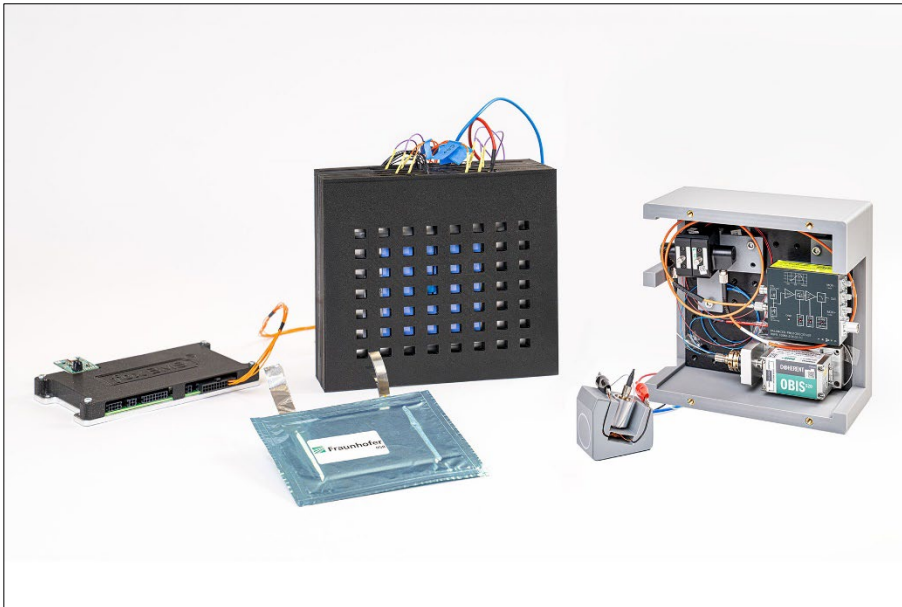
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in diamond. In comparison to conventional current sensors, the measuring range covers five orders of magnitudes. Consequently, both small and large dynamical currents can be measured with a very high resolution.

This battery system successfully validates the Al-ion based cell chemistry and its high-power capabilities for grid stabilization applications. Previously obtained results on cell level could be verified within the whole battery module by emulating instantaneous reserve applications based on real frequency data. The system proves stable performance with dynamic high current loads at 10C over long time periods and therefore demonstrates AGDIB's ability for upscaling via successful cell manufacturing, cell interconnection and system integration. A major advantage of AGDIB is that it allows for very high discharge rates and, unlike many established battery systems, also high charging rates, as required for grid applications (e.g. providing virtual inertia).

The recyclability of the cells and modules was carefully considered during development. Cell recyclability was assessed through a physical separation process that eliminates the use of toxic chemicals, thereby facilitating the establishment of closed material cycles. The module design followed a design-for-recycling strategy, surpassing current EU regulatory requirements for battery recycling efficiencies and leading to the advancement and demonstration of this sustainable energy storage system.



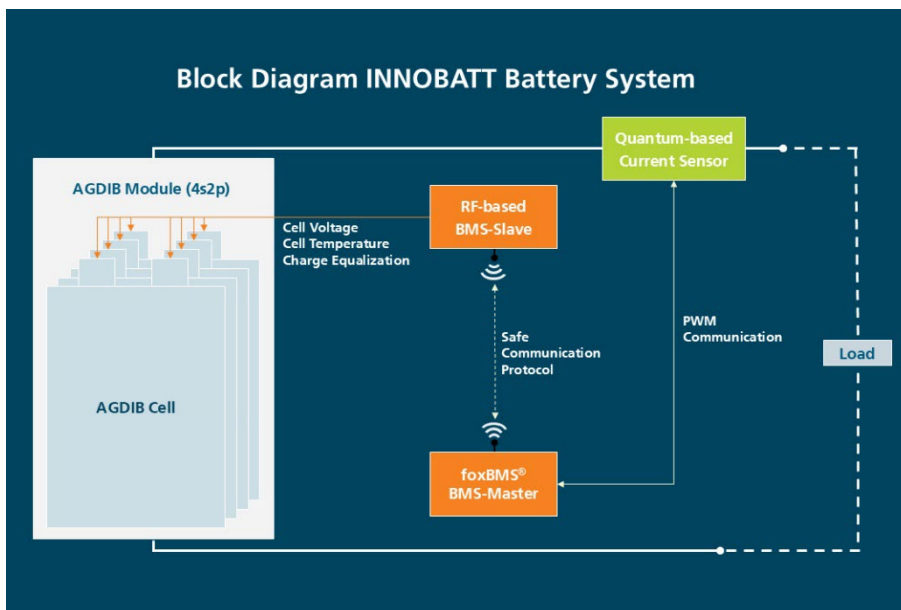
Aluminum-graphite-dual-ion battery system consisting of pouch cells, battery module, battery management system and quantum sensor.

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Block diagram with detailed components of the INNOBATT battery system.

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INNOBATT Project Partners and Funding Note

The INNOBATT project consortium consists of the Fraunhofer IISB Erlangen/Freiburg as consortium leader, the Chair of Electron Devices (LEB) at Friedrich-Alexander-University of Erlangen-Nuremberg, the Research Center Energy Storage Technologies (EST) of Clausthal University of Technology as well as the industry partners HIMA Paul Hildebrandt GmbH Brühl and ACCUREC Recycling GmbH Krefeld. INNOBATT is funded by the German Federal Ministry of Research, Technology and Space (BMFTR) as part of the "Batterie2020Transfer" program.

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