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BATTERIES & SUPERCAPS
Cover Profile

Enabling High Performance Potassium-Based Dual-Graphite Battery Cells by Highly Concentrated Electrolytes


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Invited for this month's cover picture is the group of Dr. Tobias Placke and Prof. Dr. Martin Winter from the MEET Battery Research Center (University of Münster, Münster, Germany). The cover picture shows the dual-graphite cell chemistry in the charged state, in which cations and anions are intercalated into the negative and positive graphite electrodes, respectively. The key requirements to achieve a high cycling stability are improved electrolytes and the design of effective interphases. Read the full text of the Article at 10.1002/batt.201900106.

What prompted you to investigate this topic/problem?

We like to raise attention to more sustainable and less toxic alternatives to lithium ion batteries (LIBs) that currently dominate the battery market as well as material research. Major advantages of both dual-graphite batteries and potassium-ion batteries in terms of material availability and sustainability compared to LIBs may allow these battery technologies to enter the market in specific niche applications in the future. With our systematic studies, we hope to create an improved fundamental understanding of potassium-based dual-graphite batteries, i.e., by unravelling the capacity fading mechanism as well as by gaining insights into the structural properties of the formed solid electrolyte interphase.

What aspects of this project do you find most exciting?

Combining different research areas or battery technologies is a very interesting approach to achieve synergistic effects of each individual technology. While the dual-graphite battery (DGB) cell chemistry is considered to have ecological and safety advantages, it also brings some challenges that have to be overcome. Our results show that the use of K^+ ions in a tailored highly concentrated electrolyte not only increases the sustainability of the DGB cell by elimination of expensive and toxic lithium salts and transition metals. This approach also overcomes drawbacks of the DGB cell chemistry by increasing the oxidative stability of the electrolyte. Additionally, we were able to identify reasons for decrease of capacity upon charge/discharge cycling and, hence, give a starting point for further research to improve this battery technology.

What are the main challenges in the broad area of your research?

Various emerging battery technologies are reported in literature which often promise an outstanding performance, e.g., a very high theoretical energy per volume or mass. However, in many literature reports these performance values often exclude numerous relevant parameters for practical battery cells, such as the practical mass utilization of the active material, practically achievable discharge voltages, as well as the required amount of inactive materials such as the electrolyte mass per cell capacity. As a result, the theoretical energy values that are commonly stated for these evolving battery chemistries might drastically overestimate the realistic potential of these systems in comparison to state-of-the-art LIBs. In order to establish a more transparent and realistic assessment and comparison of current and emerging battery technologies, it is highly recommended that researchers clearly and completely report their experimental parameters.

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