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BATTERIES & SUPERCAPS
Cover Profile

The Indium–Lithium Electrode in Solid-State Lithium-Ion Batteries: Phase Formation, Redox Potentials, and Interface Stability


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Invited for this month's cover picture is the group of Prof. Philipp Adelhelm from Friedrich-Schiller-University Jena, Germany. The cover picture illustrates the energy landscape of an In-Li electrode. Depending on the lithium content, the redox potential of this electrode changes. Good stability towards solid electrolytes (=low interface resistance) is only achieved at low lithium contents. Read the full text of the article at 10.1002/batt.201800149.

What is the most significant result of this study?

The development of solid-state batteries is currently an extremely dynamic field of research. On the laboratory level, the In–Li electrode is frequently used thanks to its convenient assembly and good compatibility with many solid electrolytes. Despite these advantages, the electrode itself is largely used as a "black box". Here, we could clarify how the composition of the In-Li electrode determines its properties, i.e. redox potential and stability towards sulfide solid electrolytes.

What does the cover design illustrate?

The cover design illustrates how the redox potential of the In–Li electrode depends on its composition. The more lithium, the lower the redox potential and therefore the driving force for undesired side reactions with solid electrolytes (=rise in impedance) increases.

What aspects of this project do you find most exciting?

An aspect of this project that we like in particular is the link between phase diagrams and electrode behavior. This link can be easily understood from classical thermodynamics but is often forgotten in the nowadays much more "performance driven" research. Just like in chemistry, where titration is a well-known method based on adding one liquid solution to another one, we use coulometric titration based on solids in electrochemistry. In our experiments, we formally add solid lithium to solid indium. The continuous increase in lithium content of $InLi_x$ means that we move through the phase diagram thereby gaining information on the different phases and their homogeneity range. At the same time, the measured redox potential provides information on the Gibbs energy of the reaction.

What other topics are you working on at the moment?

Our major interest is on studying fundamental properties of electrode reactions for rechargeable batteries. We focus on comparing lithium-ion and sodium-ion batteries and explore new cell concepts such as solid-state batteries or metal-sulfur batteries. Recently, we also started working on electrocatalysis.