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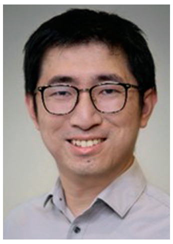
Evaluation of $Sn_{0.9}Fe_{0.1}O_{2\text{-}\delta}$ as Potential Anode Material for Sodium-Ion Batteries







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Invited for this month's cover is the group of Dr. Dominic Bresser at Helmholtz Institute Ulm (HIU). The cover picture shows the potential anode material $Sn_{0.9}Fe_{0.1}O_{2-\delta}$-C for sodium-ion batteries. Read the full text of the Research Article at 10.1002/batt.202300281.

What prompted you to investigate this topic?

The introduction of transition metals such as iron into the oxide of an alloying element as, for instance, SnO_2 has been proven to enable substantially higher capacities and superior performance when used as lithium-ion electrode material. However, nobody had explored the possibility of using this class of conversion-alloying materials for sodium-ion batteries so far. Given that most lithium-ion active materials had been tested for sodium-ion applications already, this appeared quite surprising to us. Hence, we selected (carbon-coated) $Sn_{0.9}Fe_{0.1}O_{2\text{-}\delta}$, which has been intensively investigated already for lithium-ion batteries, and studied its potential application as sodium-ion anode material. In fact, the identification of alternative sodium-ion anodes materials is critical in our opinion, since there is essentially only one material (i.e., hard carbon) at present that is considered suitable for commercial cells.

What is the most significant result of this study?

There are basically three important findings:

(1) The comparison with neat SnO_2 as reference material revealed that the introduction of iron into the tin oxide lattice enables a higher specific capacity and a greater reversibility of the de-/sodiation process – just like for lithium-ion battery applications.
(2) This improvement, however, is significantly lower compared to the effect observed for lithium-ion battery applications, as the sodiation and subsequent desodiation remain incomplete and part of the sodium appears to remain trapped in the active material after the first sodiation.
(3) The electrolyte composition, which determines the composition of the initially formed interphase between the active material and the electrolyte plays a crucial role for the achievable capacity and the reversibility of the de-/sodiation process. This is by itself not a big surprise, but the improvement when adding fluoroethylene carbonate to the electrolyte is quite substantial.
Altogether, however, there is still a lot to be better understood and we assume that one can very well improve the achievable capacity by tailoring the crystal structure, thus preventing – or at least decreasing – sodium trapping and facilitating sodium diffusion within the active material particles.