To the Media

Ulm, February 2, 2024

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Location: Helmholtzstraße 8
89081 Ulm

Paving the way to market for sodium-ion batteries based on renewable raw materials

Research project underway to develop ecofriendly energy storage for urban transportation and stationary applications

Demand for energy storage systems is on the rise all over the world. Lithium-ion batteries contain critical raw materials, so they will not be able to meet all this demand. The search for alternative battery technologies is therefore in full swing. A promising project called 4NiB, which is short for four-volt sodium-ion battery, has its sights set on this goal. The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) has joined forces with three prestigious partners to develop sodium-ion batteries. Powerful and cost-effective, these batteries are also an ecofriendly alternative. This joint project also aims to put bio-waste to productive use. The batteries will be tailored to suit urban electric vehicles and stationary battery storage systems. The German Federal Ministry of Education and Research (BMBF) is providing 1.35 million euros in funding over three years (funding code 03XP0572) for this initiative.

Joining Ulm-based ZSW in the 4NIB consortium are several renowned institutions, including the Karlsruhe Institute of Technology's (KIT) Helmholtz Institute Ulm (HIU), Forschungszentrum Jülich GmbH's Institute of Energy and Climate Research, and the University of Freiburg's Materials Research Center (FMF).

4,700 gigawatt hours by 2030

Batteries are a key component of future sustainable energy scenarios. They are indispensable for storing electricity generated from renewable sources and for powering electric vehicles. With demand for energy storage capacity forecast to grow from 700 GWh in 2022 to 4,700 GWh in 2030, vendors will not only have to produce enough batteries; they will also have to draw on vast quantities of raw materials.

Sodium instead of lithium

Sodium-ion batteries, which use sodium rather than lithium, are an emerging technology that is fast catching up. Sodium can be extracted from sources such as sodium chloride or sea salt, so it is abundant and inexpensive.

Sodium-ion batteries can be manufactured without using critical raw materials because their key components contain no cobalt, nickel or

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lithium. Costs can be further lowered by avoiding expensive copper foils current collectors. To make these batteries even more sustainable, they can be made with alternative carbon compounds sourced from renewables rather than the graphite currently used in lithium-ion batteries.

China has already started rolling out sodium-ion batteries; Europe would be well-advised to follow suit as soon as possible. However, much has yet be done to improve this new type of battery, so it will be a few years before it is mass-manufactured on an industrial scale.

Revolutionary anode technology with hard carbon replacing graphite

The 4NiB project focuses on developing and coordinating anodes, cathodes and electrolytes to build a high-performance sodium-ion battery that is both cost-effective and ecofriendly. The project's primary goal is to deliver a high performance cell in pouch format with specific energy greater than 200 watt-hours per kilogram.

The priority on the cathode side is to create high-voltage cathodes with four volts by developing polyanions-based mixed phosphates that are safe and remain at stable at high voltages. Researchers are using simulations to determine the right composition of transition metals to maximize stored energy. The anode is to be produced with hard carbon sourced from bio-waste, using feedstock products that are abundant in Germany.

A non-aqueous liquid will serve as the electrolyte. An added ionic liquid is to increase conductivity and safety. Researchers are also working on pre-charging strategies to maximize these batteries' energy.

About the ZSW

The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) is one of the leading institutes for applied research in the major topics of the energy transition: Photovoltaics, wind energy, batteries, fuel cells, electrolysis, eFuels, circular economy, policy advice and the use of AI for process and system optimisation. Together with industry, we pave the way for new technologies to enter the market. More than 300 colleagues and around 100 scientific and student assistants work at the ZSW locations in Stuttgart and Ulm. The ZSW operates a test field for wind energy and another test field for PV systems. The ZSW is a member of the Baden-Württemberg Innovation Alliance (innBW), an alliance of ten business-related research institutions.

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Researchers are pursuing the 4NIB project to develop sodium-ion batteries for urban transportation and stationary use cases.

Photo: ZSW