New low-cost battery could help store renewable energy

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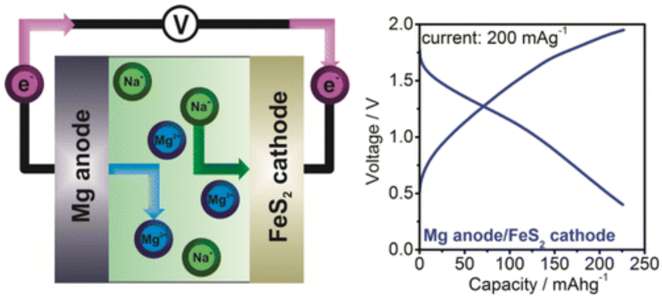

Wind and solar energy projects are growing at a respectable clip. But storing electric power for days when the air is still or when the sun goes down remains a challenge, largely due to cost. Now researchers are developing a new battery that could bring the price of storage to more affordable levels. They report their new battery that uses low-cost materials—sodium and magnesium—in ACS' journal *Chemistry of Materials*.

Today, lithium-ion batteries are the storage technology of choice for many applications, from electric cars to smartphones. And, it appears, saving up power for homes is next. For example, Tesla, the maker of luxury electric cars, is ambitiously expanding its lithium-ion technology to fill that niche and has already started rolling out systems to homeowners in a pilot project. But the $3,000 price tag for the pack itself plus installation costs put it out of reach for most customers. To make larger-scale energy storage more accessible, Maksym V. Kovalenko and colleagues wanted to develop an affordable alternative to lithium-ion.

The researchers started with magnesium as the battery's safe, inexpensive and high-energy density anode material and paired it with pyrite, which is made of iron and sulfur, as the cathode. The electrolyte—the electrically conducting component—contains sodium and magnesium ions. Testing showed that the resulting device's energy density was close to that of lithium-ion batteries. It could get an additional two- to three-fold boost with further development of magnesium electrolytes. And because it's made with low-cost materials, it could one day help support grid-scale energy storage, the researchers say.

More information: Marc Walter et al. Efficient and Inexpensive Sodium–Magnesium Hybrid Battery, *Chemistry of Materials* (2015). DOI: 10.1021/acs.chemmater.5b03531

Abstract
We present a hybrid intercalation battery based on a sodium/magnesium (Na/Mg) dual salt electrolyte, metallic magnesium anode, and a cathode based on FeS2 nanocrystals (NCs). Compared to lithium or sodium, metallic magnesium anode is safer due to dendrite-free electroplating and offers extremely high volumetric (3833 mAh cm–3) and gravimetric capacities (2205 mAh g–1). Na-ion cathodes, FeS2 NCs in the present study, may serve as attractive alternatives to Mg-ion cathodes due to the higher voltage of operation and fast, highly reversible insertion of Na-ions. In this proof-of-concept study, electrochemical cycling of the Na/Mg hybrid battery was characterized by high rate capability, high Coulombic efficiency of 99.8%, and high energy density. In particular, with an average discharge voltage of ?1.1 V and a cathodic capacity of 189 mAh g–1 at a current of 200 mA g–1, the presented Mg/FeS2 hybrid battery delivers energy densities of up to 210 Wh kg–1, comparable to commercial Li-ion batteries and approximately twice as high as state-of-the-art Mg-ion batteries based on Mo6S8 cathodes. Further significant gains in the energy density are expected from the development of Na/Mg electrolytes with a broader electrochemical stability window. Fully based on Earth-abundant elements, hybrid Na–Mg batteries are highly promising for large-scale stationary energy storage.

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