Sodium ion batteries definition

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Lithium-ion (Li-ion) technology dominates the current battery market, offering high energy density, long life and continually decreasing costs. But lithium isn’t perfect, and it isn’t the only game in town.

Sodium-ion battery technology is a promising Li-ion alternative. In this article, we’ll explore how sodium-ion batteries work and how they compare to Li-ion.

Intro to Sodium-ion Batteries

A sodium-ion (Na-ion) battery is a type of rechargeable battery that uses sodium ions as charge carriers. Na-ion batteries are similar in design and construction to Li-ion batteries, but they use sodium compounds in place of lithium.

Sodium-ion batteries contain sodium-based electrodes and (typically) liquid electrolytes with dissociated sodium salts in solvents. When these batteries are charging, sodium ions travel from the cathode into the anode, and the electrons travel through the external circuit. Discharging reverses the process, with sodium ions traveling from the anode and reintegrating in the cathode, while the electrons travel through the external circuit. The typical cell voltage of a sodium-ion battery is 2.3–2.5V.

Sodium-ion Battery Cathodes

Generally, there are three variations of sodium-ion battery cathodes: polyanion, Prussian blue analogs (PBAs), and layered oxides. Polyanion and PBA cathodes have low atomic packing density, which results in low volumetric energy density. This allows them to be used in tools and starter applications. In contrast, layered oxide cathodes have both higher volumetric and gravimetric energy densities, which is better suited for grid energy storage systems (ESSs).

Rare elements such as nickel and cobalt can be used to increase the energy density of Na-ion cathodes. These elements enable higher reversible capacity and nominal voltage. However, these elements have a high cost and pose safety and environmental concerns in manufacturing and battery end of life.

Layered oxide cathodes are the most studied type of Na-ion battery cathode. Today, lithium, nickel and cobalt

are typically used in these cathodes. However, replacing these rare materials with sodium, iron and magnesium could potentially maintain their high performance while lowering costs. According to a 2020 essay in Advanced Energy Materials by Hayley S. Hirsh et al., the material cost of a particular rock salt (Na2/3Fe1/3Mn2/3O2) is less than one-fifth that of cathodes containing lithium and nickel. The cathode is the most expensive part of a Na-ion battery, according to the essay, accounting for 44 percent of the total battery cost.

Sodium-ion Battery Anodes

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