ZINC-ION BATTERIES

Charge with air

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Recharging a battery requires an external power source, be it an electric grid or an energy-harvesting device. Integrating an energy-harvesting device such as a triboelectric nanogenerator with a rechargeable battery is sometimes considered as a self-charging power system. However, triboelectricity generation still requires external mechanical energy, not to mention the additional production and cost complexity associated with the integration. Now, Zhiqiang Niu and colleagues from Nankai University, China, design an aqueous Zn-ion battery that can simply be self-charged by a spontaneous reaction between a water-containing cathode ($\text{CaV}_6\text{O}_{16} \cdot 3\text{H}_2\text{O}$) and oxygen dissolved in the electrolyte.

In their Zn-ion battery, Zn^{2+} ions are intercalated into the cathode upon discharge. This leads to the formation of $\text{CaZn}_{3.6}\text{V}_6\text{O}_{16} \cdot 3\text{H}_2\text{O}$. Conversely, Zn^{2+} ions are extracted from the cathode upon charge. This changes the cathode to an oxidized state, $\text{CaZn}_{3.6-x}\text{V}_6\text{O}_{16} \cdot 3\text{H}_2\text{O}$. The charge process would need an external power supply. However, Niu and team show that, when they dissolve O_2 into the electrolyte, the discharge product $\text{CaZn}_{3.6}\text{V}_6\text{O}_{16} \cdot 3\text{H}_2\text{O}$ can be spontaneously oxidized to $\text{CaZn}_{3.6-x}\text{V}_6\text{O}_{16} \cdot 3\text{H}_2\text{O}$. This means that the chemical reaction between O_2 and the cathode enables the same process as in the normal electrochemical charging, but without any external power supply. To demonstrate the self-charging, the researchers use holes drilled on the cathode cap to allow air (O_2) to diffuse into the electrolyte and react with the cathode whenever charging is needed. Repeated chemical charging and electrochemical discharging cycles are reported.

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