July 2, 2024
Enpower Japan Corp.
SoftBank Corp.

SoftBank Corp. and Enpower Japan Corp. Successfully Develop All-Solid-State Batteries with High Energy Density

Batteries achieve specific energy of 350 Wh/kg

Enpower Japan Corp. ("Enpower Japan") and SoftBank Corp. ("SoftBank") announced they succeeded in developing all-solid-state batteries technology, such as increasing the active material ratio by homogenizing the solid electrolyte and thinning the solid electrolyte layer, and successfully verified a specific energy of 350Wh/kg in an all-solid-state battery cell with lithium metal anode.

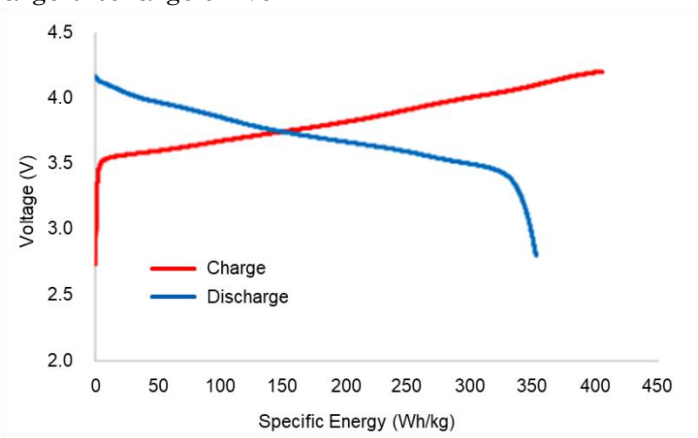
Enpower Japan and SoftBank have been conducting research and development of next-generation batteries with high specific energy (Wh/kg). The batteries are lightweight and have large capacity for use in High Altitude Platform Stations (HAPS), which provide telecommunication services from the stratosphere. So far, the two companies successfully verified a liquid-type lithium metal battery cell with specific energy of 520Wh/kg*1, and then achieved a specific energy of 300Wh/kg in the all-solid-state battery *2.

Enpower Japan and SoftBank aim to achieve a specific energy of 400Wh/kg for HAPS batteries during the 2024 fiscal year ending March 31, 2025, and then to achieve a battery life of more than 1000 cycles during the 2026 fiscal year.

*1 Please refer to the press release dated November 21, 2021:
"SoftBank Makes Great Progress in the Next-generation Battery Development, Successfully Verifying Three New Technologies Including Development of Cathode Materials for Solid-state Batteries"
https://www.softbank.jp/corp/news/press/sbkk/2021/20211102_01/ (in Japanese)

*2 Please refer to the press release dated August 24, 2023:
"SoftBank Corp. and Enpower Japan Corp. Successfully Developed All-Solid-State Batteries with High Energy Density. Batteries achieving specific energy of 300 Wh/kg"
https://www.softbank.jp/corp/news/press/sbkk/2023/20230824_01/

■350 Wh/kg battery cell and charge-discharge curve



Enpower Japan and SoftBank previously succeeded in the development and verification of

all-solid-state batteries with specific energy of 300Wh/kg by reducing the interface resistance between the cathode and solid electrolyte layer, reducing the weight ratio of the solid electrolyte in the cathode mixture, and reducing the thickness of the solid electrolyte layer. This time, to further increase specific energy, development has been focused on improvement of the homogeneity of the materials to reduce interface resistance.

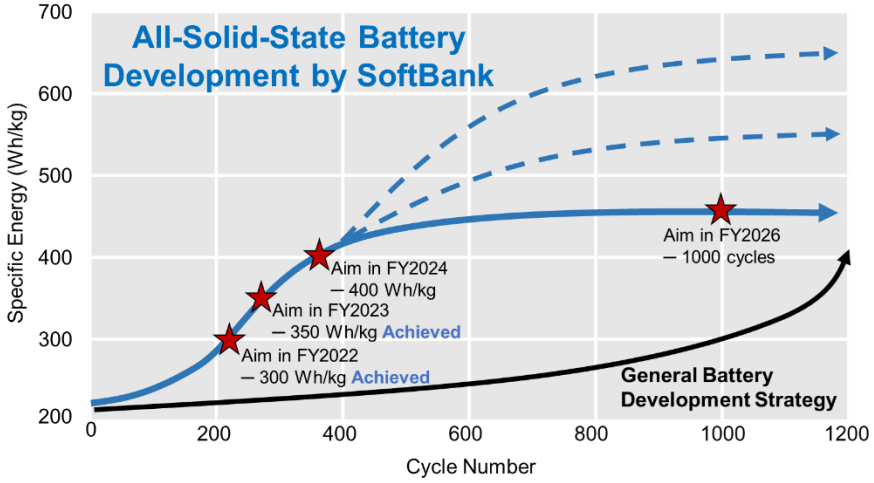
Solid electrolyte, unlike liquid electrolyte, shows low adhesion on the interface of the cathode active material and solid electrolyte. This increases the interface resistance related to ion conductivity, which cause reduction of battery capacity, decrease in output characteristics and cycle life characteristics, and leads to difficulties in formation of the interface between the cathode active material and solid electrolyte, and solid electrolytes themselves.

To solve these issues, Enpower Japan and SoftBank succeeded in the homogenization of the solid electrolyte by controlling the particle size of the solid electrolyte by means of adjustment of the particle size in the raw materials and improvement of the grinding process, as well as improving the dispersion of particles in the film formation process. This approach improved the dispersion of the conductive material, increasing the utilization rate of the cathode active material, and improving the smoothness of the electrode layer to form a good interface between the electrodes, which realized a high capacity over a large area and suppressed short circuits. As a result, the companies succeeded in increasing the specific energy of the all-solid-state battery cell with lithium metal anode to 350Wh/kg.

Regarding circle life characteristics, Enpower Japan and SoftBank have achieved 200 cycles at the electrode level, but the short circuit occurring during cycles remains as an issue in large-area pouch cells. Both companies will continue to develop further homogenization technology for materials and electrodes to make it possible to prevent a short circuit for the large-area electrodes or the stacked structure.

Enpower Japan and SoftBank will continue research and development to increase the capacity of next-generation batteries, aiming to achieve specific energy of 400 Wh/kg in 2024 fiscal year, and then, in 2026 fiscal year, increase the battery life to more than 1000 cycles. They will also develop core technologies to reduce pressure in compression mechanism. This will contribute to further improvement of the solid-state batteries performance and promote the batteries practical use, while also promoting the battery use in the aviation field, including HAPS and drones, as well as in IoT devices and automotive applications, thereby contributing to solve current social issues in a multi-faceted way using next-generation batteries.

■All-Solid-State Battery Development by Softbank



For more information on this activity, please visit the SoftBank Research Institute of Advanced Technology website.
https://www.softbank.jp/en/corp/technology/research/story-event/055/