

October 13, 2021
Maxell, Ltd.

1st in the World*¹ to Start Sample Shipment of Sulfide Based Coin Type All-solid-state Battery Specialized for High Voltage and High Output

Adopting a bipolar structure that can output 5 V or higher by utilizing the characteristics of all-solid-state batteries



Sample image of the developed cell (φ9 mm)

Maxell, Ltd. (President and Representative Director: Keiji Nakamura, hereinafter "Maxell") has successfully developed a coin type all-solid-state battery (hereinafter referred to as "the battery") specialized for high voltage and high output by adopting a sulfide based solid electrolyte. The battery achieves high voltage and high output by adopting a bipolar structure that utilizes the characteristics of all-solid-state batteries. The battery is recommended with respect to new perspectives of development, i.e. high voltage and high output, rather than high energy density, in order to meet the diverse needs of the market. The battery possesses the characteristics of Maxell's all-solid-state battery, including a wide temperature range, long life*², and high safety*³. Maxell plans to start a sample shipment in November 2021.

Maxell has been developing lithium-ion batteries and micro batteries for many years. It has successfully developed the battery by improving resistance, something which has been a challenge, by merging the accumulated technologies during the development of the all-solid-state battery.

The battery achieves a voltage of 5 V - approximately two times the output of the coin type all-solid-state battery announced in September 2020 (hereinafter referred to as "the coin type all-solid-state battery") - and output of approximately five times that of the aforementioned coin type all-solid-state battery. The higher voltage was achieved by deepening the "High Precision Molding & Forming" technology, one of Maxell's Analog Core Technologies*⁴, to obtain lower resistance due to a high filling ratio and to establish a bipolar structure. The battery can be used to obtain a high voltage and save space compared to conventional coin type all-solid-state batteries (by approximately 50%). Furthermore, its improved output characteristics have expanded the operating range at low temperatures. With the ceramic package released in March 2021, it can be surface-mounted on the board.

Main characteristics of the high-voltage, high-output sulfide based coin type all-solid-state battery

1. Voltage of 5 V
2. Discharge output that is five times*⁵ as high
3. Quick charge available (charges to 90% in approximately 30 minutes)

4. Operable in a temperature environment of -60°C to 125°C
5. Can be mounted on the board (with the ceramic package)

The battery is suitable for a wide range of applications, including emergency power and backup power for devices required to produce outputs in a severe temperature environment, which has been difficult to achieve. This technology utilizing the bipolar structure is expected to be used for in-vehicle applications in the future.

Maxell has 71 patents pending in Japan and worldwide for its technologies related to all-solid-state batteries, including the coin type, ceramic package, and high voltage.

Maxell's all-solid-state batteries, including the battery referred to in this article, are expected to contribute to the realization of a maintenance free society due to long life*² and high safety*³.

Maxell will contribute to solving social issues, such as SDGs, through the improvement of the performance of all-solid-state batteries and ongoing commercialization of high-performance all-solid-state batteries.

*1 1st in the World: Among sulfide based coin type all-solid-state batteries. As of September 16, 2021.

According to a survey by Maxell

*2 Long life: One of the features of Maxell's all-solid-state battery using sulfide based solid electrolytes. Web page of Maxell's all-solid-state battery

https://biz.maxell.com/en/rechargeable_batteries/allsolidstate.html

*3 High safety: One of the features of Maxell's all-solid-state battery using sulfide based solid electrolytes. Web page of Maxell's all-solid-state battery

https://biz.maxell.com/en/rechargeable_batteries/allsolidstate.html

*4 Analog Core Technologies: Unique technologies that Maxell has been developing and handing down in the areas of processing, molding, and forming of materials, which make up the DNA of the company. The collective term for the three technologies that are indispensable for Maxell's manufacturing, namely Mixing & Dispersion, Fine Coating, and High Precision Molding & Forming.

<https://www2.maxell.co.jp/corporate/analogcore.html>

*5 Five times: Compared to the coin type all-solid-state battery released in September 2020.

Bipolar structure

In a bipolar structure, the cathode and the anode are placed with current collectors. The units can be layered to form a series inside the battery. In a conventional lithium-ion battery, the concentration of electrode reactions occurs when the electrolyte solution comes into contact with all the electrodes, which must be avoided. In an all-solid-state battery, this structure can be implemented without making any significant change in the structure or process because it uses no electrolyte solution.

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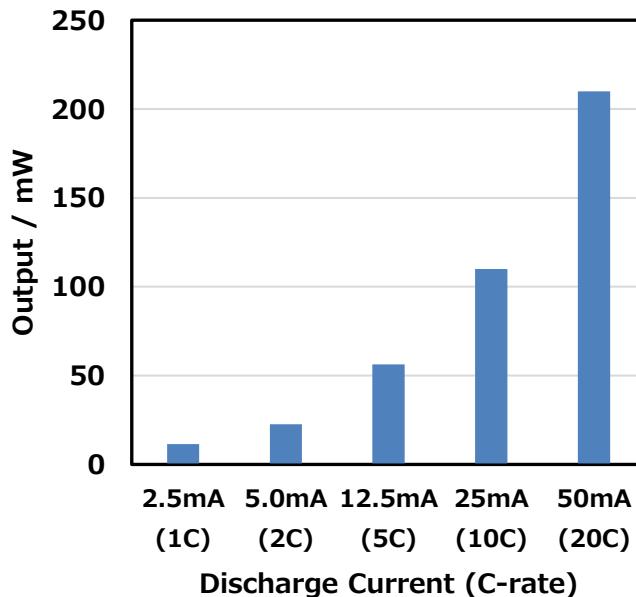
https://www.maxell.co.jp/inquiry/maxell/en/form.jsp?f=biz&q=rechargeable_batteries_sales_en_biz

Appendix

Characteristics of the high-voltage, high-output sulfide based coin type all-solid-state battery

1. Output characteristics

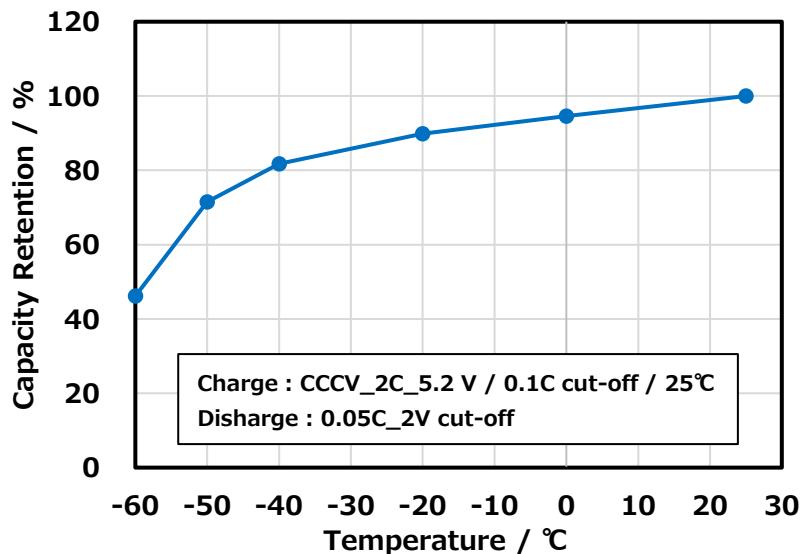
The battery can supply a large current despite its small size.



Output characteristics ($\phi 9$ mm cell, at room temperature)

2. Low-temperature discharge characteristics

The battery can discharge at low temperatures, something which has been difficult to achieve with conventional lithium-ion batteries.



Low-temperature discharge characteristics ($\phi 9$ mm cell)

Voltage and capacity

Cell	Maximum voltage (V)	Nominal voltage (V)	Nominal capacity (mAh)
9 mm φ	5.2	4.6	2.5

* The values are for a sample product and may be different at the time of mass production.



Measuring cell voltage