NewsRelease

NIPPON SHOKUBAI

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The Development of Environmentally Friendly Rechargeable Carbon-zinc Hybrid Battery

NIPPON SHOKUBAI CO., LTD. (Headquarter: Osaka Chuo-ku, President: Yujiro Goto, hereinafter “Nippon Shokubai”) has developed a novel rechargeable zinc battery by combining activated carbon with a"zinc battery separator" and "zinc anode" with the use of our unique technology. This new rechargeable zinc battery is made of resource-rich and non-toxic materials such as water, carbon and zinc and there is no fear of burning because it is a water-based battery. In addition, this battery has excellent output performance and low-temperature performance. Although the extension of battery life has been a challenging issue for rechargeable zinc batteries, our developed novel separator/zinc anode technology has achieved long a life of 10,000 cycles or more.

Zinc batteries, rechargeable batteries that use zinc for the negative electrode, have very long history that even Volta and Edison also had studied. In contrast to lithium-ion batteries which are small and lightweight, rechargeable zinc batteries focus on safety. The characteristics of zinc batteries are the high safety of using an aqueous electrolyte solution like a lead-acid battery, high environmental friendliness without the use of toxic materials such as lead, and elemental advantages without using rare metals. Therefore, rechargeable zinc batteries are expected to play a primary role in next-generation storage batteries.

However, the biggest weakness of zinc batteries has been their charge-discharge cycle life. The major cause is that a short circuit between the positive electrode and the negative electrode occurs when needle-like zinc metal crystals grow toward the positive electrode during repeated charging and discharging.
For this reason, it has been considered common knowledge that zinc anodes can be used for primary batteries but not for secondary batteries.

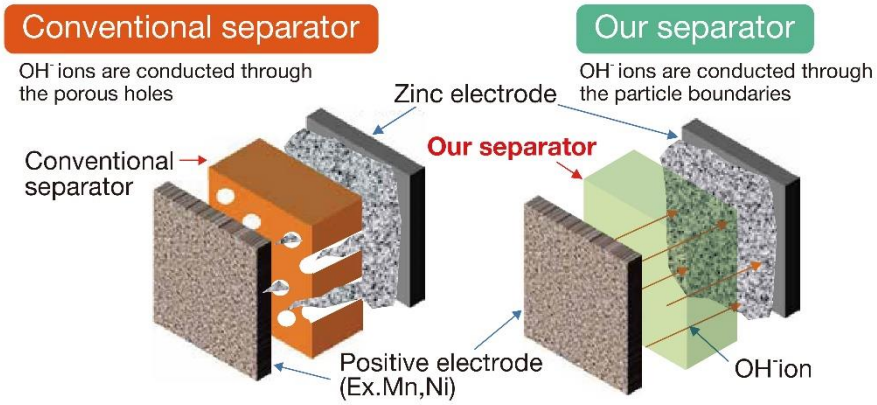

Fig.1: Schematic diagram of conventional separator and Nippon Shokubai-developed separator

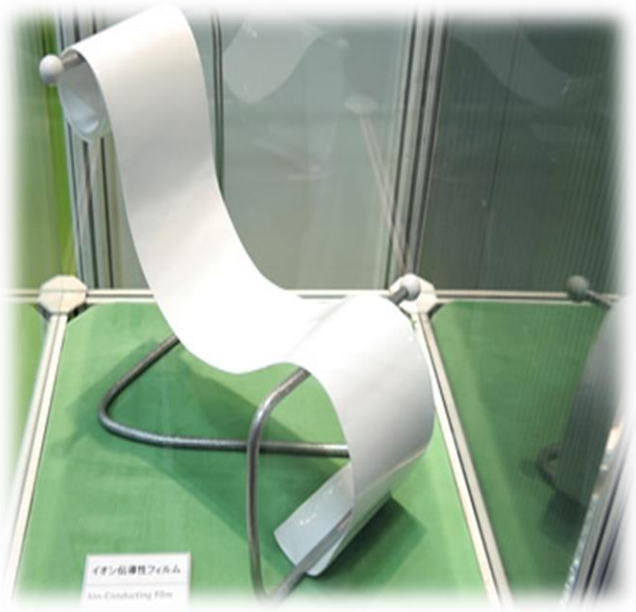

Fig.2: Photo of Nippon Shokubai's separator developed for zinc battery

Therefore, Nippon Shokubai has succeeded in suppressing this short circuit due to needle-like zinc metal crystals by developing the novel separator with original structure using mineral powder (Fig.1 and 2). In addition, we have also developed the novel zinc negative electrode that can suppress deterioration due to repeated charging and discharging.
By combining the separator and zinc negative electrode with activated carbon as the positive electrode, Nippon Shokubai has developed the new rechargeable carbon-zinc hybrid battery.

This hybrid battery is assembled from a positive electrode of an electric double layer capacitor and a zinc electrode of electrochemical reaction (Fig.3).
The hybrid battery has the advantages of an electric double layer capacitor (EDLC), such as high power and long cycle life, and overcomes the low capacity of an EDLC by using battery materials as zinc anode.

Since the zinc anode has high energy density, it is possible to make the anode thinner, and by mounting more activated carbon in the empty space, the hybrid battery can achieve 5 to 10 times the electric capacity of an EDLC with the same volume. Therefore, this hybrid battery can achieve the same capacity performance as lead-acid batteries.

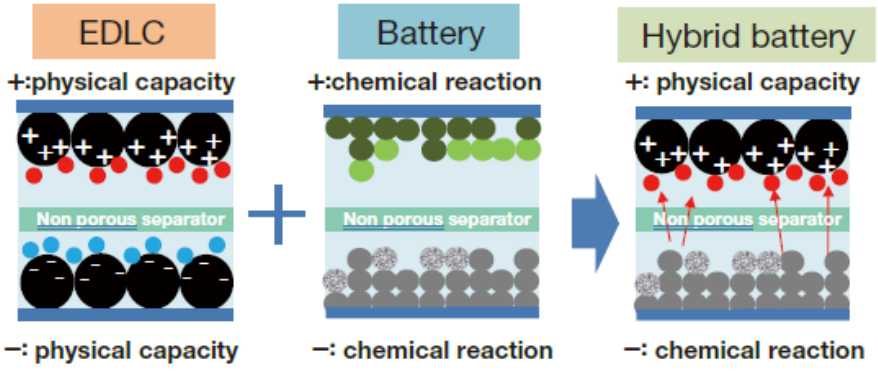

Fig.3: Hybrid structure of physical and chemical batteries

Moreover, the rechargeable carbon-zinc hybrid battery can be charged and discharged even at

low temperatures below -20℃, while keeping the high output of the capacitor. Many other batteries are difficult to charge, especially at low temperatures, because the rate of chemical reactions is closely related to temperature. On the other hand, the reaction of this battery using a zinc electrode is very fast, enabling high-speed charging and discharging from low to high temperatures(-20℃～90℃) like an EDLC.

However, the cycle life of the hybrid battery depends on the performance of the zinc anode because of needle-like zinc metal crystals growing. Regarding the charge/discharge cycle life of rechargeable zinc batteries, the self-developed novel separator/zinc anode technology has a long life of 10,000 cycles or more. The use of our novel separator/zinc anode developed by Nippon Shokubai's original technology has already achieved the charge/discharge life of 10,000 cycles or more, which is more than 100 times that of a lead-acid battery that reaches a life of about several hundred cycles.

Therefore, it is expected to be used in applications, such as in-vehicle batteries where conventional lead-acid batteries are used, and new applications such as power storage of renewable energy are expected in the future.

The "rechargeable carbon-zinc hybrid battery" and "zinc battery separator" (Fig.2) will be exhibited at a Nippon Shokubai booth at Battery Japan 2020, which will be held at Aomi Hall, Tokyo Big Sight, from February 26 (Wed.) to 28 (Fri.).

About NIPPON SHOKUBAI Co., Ltd.: Since 1941, Nippon Shokubai has grown up its business with unique catalyst technology. Nippon Shokubai has supplied, for example, ethylene oxide, acrylic acid, automobile catalysts, process catalysts and so on. Among all, our global market share of superabsorbent polymer is the largest in the world now. Nippon Shokubai is a global chemical company operating under its corporate mission "Providing affluence and comfort to people and society with our unique technology." http://www.shokubai.co.jp/en/

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