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Lithium Ion Battery: An Era of Portable Energy and the Nobel Prize 2019

Prashant Mishra*

Institute of Advanced Materials, VBRI, Gammalkilsvägen 18 Ulrika 590 53, Sweden

*Corresponding author: E-mail: prashant.mishra@iaam.se

For several years, nickel-cadmium had been the only panacea for powering up the electronic equipment, be it a mobile phone, car, laptop or any devices you just name it, we had to count on nickel-cadmium based batteries. Fortunately, three genius minds finally came up with a promising solution and laid the foundation of lithium-ion batteries' legacy. The lithium-ions had been invented many decades ago though, but these Nobel laureate: John B Goodenough, M Stanley Whittingham and Akira Yoshino bring it to life [1-5].

Today, lithium-ions are not only widely accepted but also the most promising future-oriented power unit which requires low maintenance [6-10]. Furthermore, there is no memory and scheduling process in order to prolong life. Speaking of its self-discharge cycling, it is very less than compared to nickel-cadmium.

Despite having plenty of advantages, it has a few considerable drawbacks too. Lithium-ions are likely to cause little harm when one disposes of them. Moreover, they are fragile and requires watching over by a protection circuit to make sure the safe operation. Ageing is also an undeniable major concern with them, whether the battery is operational or not it would hardly last for five or six years.

Lithium-ions have been in the news lately, not because they tend to burst into flames often but because the development of the lithium-ion battery has won the chemistry Nobel Prize. The three Nobel laureate made the impossible possible; they created the lighter and most power-efficient version of lithium power units. Our smartphones, laptop computer, miniaturise equipment and millions of power-consuming gadgets are relying on them. Therefore, the Royal Swedish Academy of Sciences recognised their work and announced the 2019 Nobel Prize in Chemistry to these scientists in coming December.

So, the question is, what so special about these batteries, and what makes them so energetic and popular? To this end, let's understand the basics first.

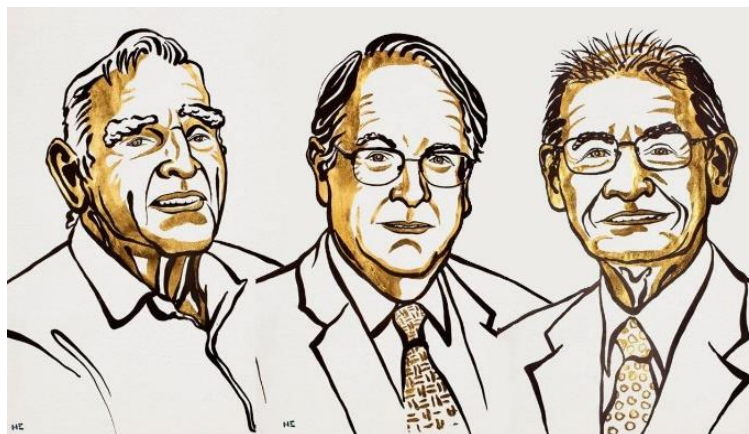


Fig. 1. 2019 Nobel Prize in chemistry was jointly awarded to John B. Goodenough, M. Stanley Whittingham, and Akira Yoshino (left to right). (<https://www.nobelprize.org/prizes/chemistry/>).

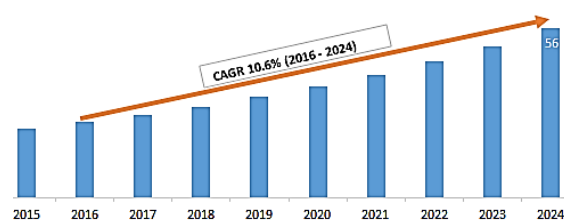


Fig. 2. Lithium ion battery market size and forecast, 2015 to 2024 (US\$ Billion), Source: Variant Market Research.

How does a lithium-ion battery work?

It is made up of a cathode, anode, electrolyte, separator and the negative & positive current collectors. The cathode and anode are used to store up the lithium-ions which further is positively charged with the help of electrolyte from the anode to the cathode and opposite to that through the separator. When the lithium-ions produce the free electrons in the anode, the positive current collector got recharged. Thereafter, the separator comes into the picture and obstacles the flow of electrons inside the battery. At last, the electrical current flows from the positive locator through a device.

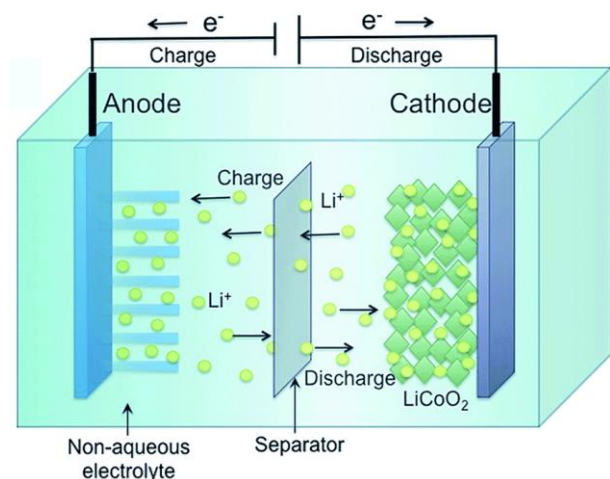


Fig. 3. The charging and discharging process of Li-ion battery, reproduced with permission from Qi *et. al.*, 2017 [6].

Some pros of Lithium-ions

- **Lighter than any other types of batteries**

Believe it or not, any power unit based on lithium-ions are quite lighter than any other recharge unit of the same size. Why? Because lithium and carbon both produce together airy-kind electrodes. Moreover, it can reserve a plethora of power in its atomic shells considering lithium a highly reactive element.

- **Power efficient**

A typical lithium-ion provides long-lasting power. When comes to storing, it can store 150 watt-hours of electricity in just 1 kg of the power unit. Not only that, it is durable and can hold the charge for a long time without releasing of its 95 percent of its charge per month, compared to NiMH and lead-acid battery.

- **Zero memory effect**

One may recharge a lithium-based battery without completely discharging it. Means you do not actually have to discharge it before plugging in the power socket. Sadly, this is not the case with other kinds of power units. Besides, a lithium-ion battery is sufficient to hand a hundred, a thousand of charge and discharge pattern.

Some Cons

- **Ageing process**

Whether you use them or not, but once you have purchased a lithium-ion battery, it will start the ageing process and will long-last three to four years. However, there are many techniques to slow down the degradation but those are not one hundred percent reliable.

- **Reactive to high temperatures**

Lithium-ions are extremely reactivable under the high temperatures than any other types of batteries. And when it comes under heat, it starts to break down from the very first minute.

- **Almost dies when completely got discharged**

Once a lithium-ion power unit completely runs out of power, it ruins. Therefore, it is required to keep a minimal power supply in it in order to utilise the best of it.

Conclusion

The enhancement of lithium-ions is still in the pipeline; they have not yet fully matured, but a million thanks to John B Goodenough, M Stanley Whittingham and Akira Yoshino for bringing out the optimal of it. And a sincere appreciation to the Royal Swedish Academy of Sciences for recognising their outstanding contribution in the energy storage sector.

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Notes

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