THIN, FLEXIBLE, SHEET FORM

KURABO

Development of Film Style Flexible Lithium-ion Battery

Market creation potential by combining with Thin-Film Solar Cells

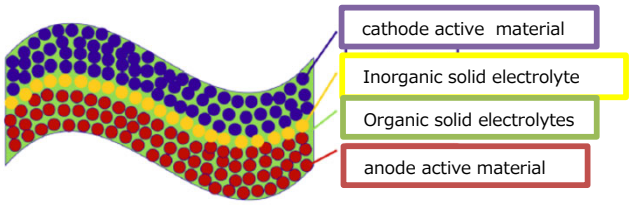
Why?

Lithium-ion batteries are widely used in portable electronics and vehicles. However, there is no film-type battery that is thin and can be made larger in area.

We have developed a technology for manufacturing **energy storage films that are thin, flexible, and can easily be made large in area** by printing and sealing solid-state lithium-ion batteries without electrolyte in films. By combining this technology **with flexible power generation technology**, we believe that a new market can be created.

What is a Film Battery?

A flexible thin-film battery can be made by pasting the battery's cathode, anode, and electrolyte materials (solid powder particles) and printing them on a film, then impregnating the organic resin electrolyte between each particle.



Features and Advantages

Pros:	Cons:
✓Thin and flexible	✗Low output voltage
✓light and large	~~✗Low charge capacity~~
✓Can be produced in large quantities (low cost)	~~✗Not for fast charging~~ ✓Automatically charge itself when there is a light
✓safe *non-flammable	
✓long lasting	

COMBINE THESE BENEFITS WITH SOLAR CELLS

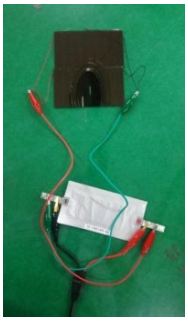
TURN DISADVANTAGES INTO ADVANTAGES

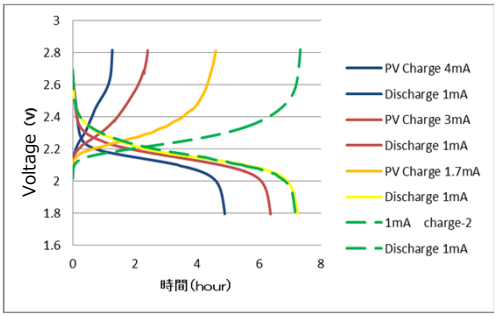
When film batteries are used as "devices" that efficiently store solar energy rather than as just “batteries”, a new value will be created.

Solar Cell connection Charge/Discharge Characteristics

Since film batteries are solid-state batteries, they can be safely charged by directly connecting solar cells without a charge control circuit.

The following table shows the measurement results of charge/discharge characteristics (capacity change) when a film battery is charged with a different output (irradiation light intensity) of the solar cell. Charging for about 5 hours yields 100% capacity, When the light irradiation intensity to the solar cells was increased to double the charging speed (2.5 hours), the storage capacity was approx. 90%, and even when the solar cell output was further increased to speed up the full charge time to 1.25 hours, the capacity retention rate was maintained at approx. 70%.





Applications

NO TROUBLESOME CHARGING OPERATIONS

Social impact of 5G

Reference: Ministry of Internal Affairs and Communications https://www.soumu.go.jp/main_content/000633132.pdf

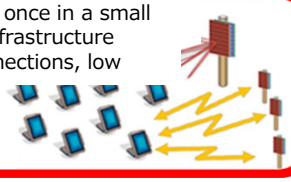
Ultra high speed	Maximum 10Gbps
Ultra low latency	Delay 1ms
Multiple simultaneous connections	Number of connections 1 million devices/km2

Trillion Sensors Universe

ANYWHERE ANYTIME

Too many connections at once in a small area, smart meters, IT infrastructure management (many connections, low power IoT)

Countless numbers of sensors and devices



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Development of Thin-Film Lithium-Ion Battery

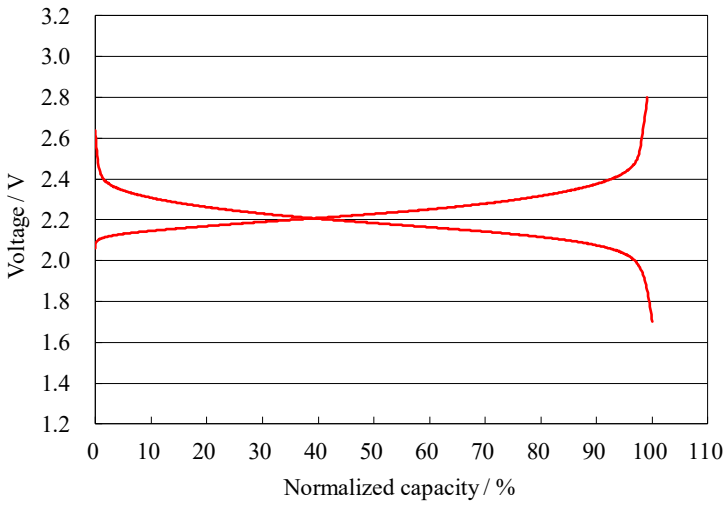
Feature & Benefits

- Ultra thin
- Flexible
- Low weight
- Capable for wide square
- Easy charging
- Safety
- Connectible to solar cell

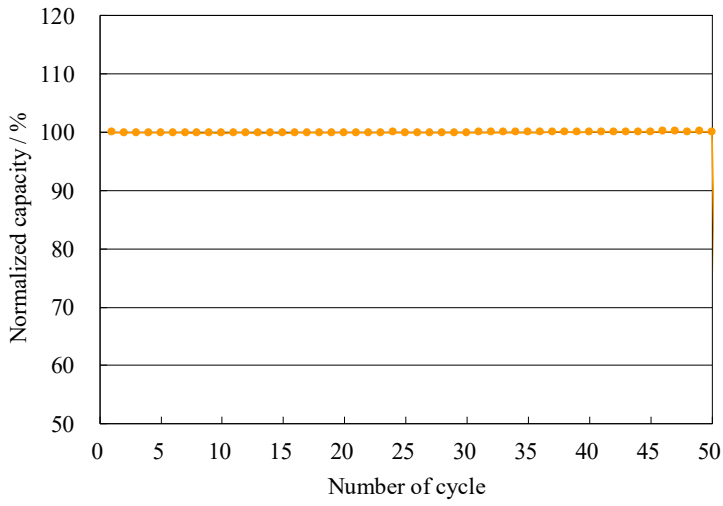
Specifications

Capacity	0.4 mAh/cm2
Nominal voltage	2.2V
Charging	0.18mA, C.C.Charge, 2.8V cutoff
Weight	0.18 g/cm2
Energy density	Volumetric: 88Wh/l Gravimetric: 4.9Wh/kg

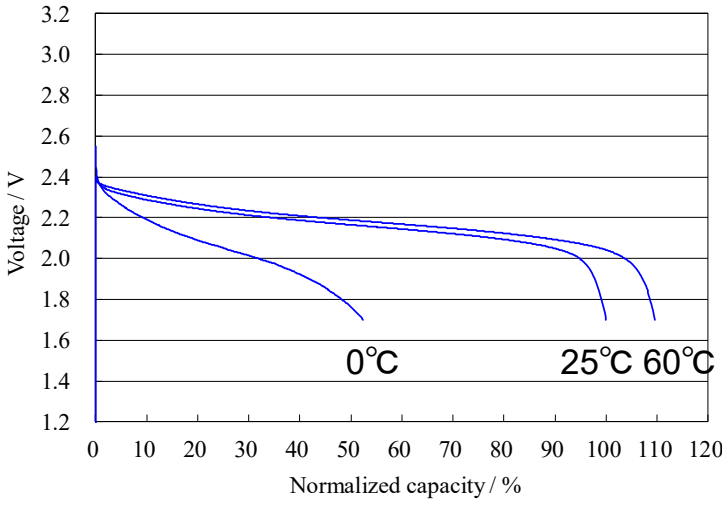
Charge-Discharge Characteristics



Cycle Life Characteristics



Discharge Characteristics (by temperature)



Discharge Characteristics (by rate of discharge)