

Introduction into SIB technology

**ALBA New Technology Seminar
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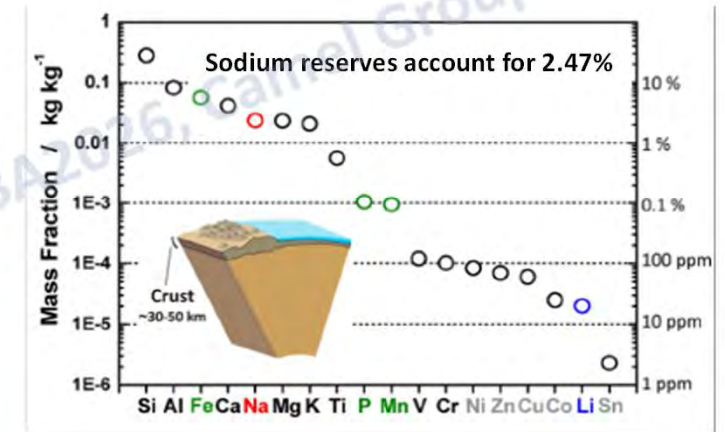
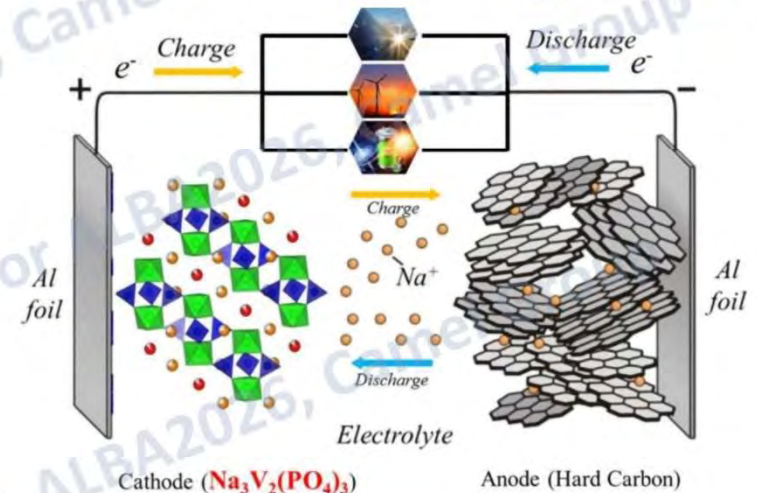
Background introduction to sodium-ion battery



Basic characteristic



- Sodium resources are abundant, and the Na/Li reserve ratio is 420
- The lithium battery manufacturing process can be used as a reference
- The anode electrode does not need Cu foil as a current collector
- The energy density is 2~3 times higher than that of lead-acid batteries



Comparison among SIBs vs Lead acid battery vs LIBs

Items	Sodium Ion Battery	Lead Acid Battery	LFP Battery	Evaluation
Low-Temp	Good, supports discharge at -40°C; capacity retention >90% at -20°C	Poor, capacity retention <60% at -20°C	Poor, capacity retention <70% at -20°C	Better low-temp continuous discharge capability
High-Temp	Good, supports 80°C use	Poor, easy to swelling	Good, supports 60°C use	Better high-temp continuous discharge capability
Storage Life	Self-discharge <5% per month	Self-discharge >10% per month	Self-discharge <5% per month	Can be stored longer without frequent recharging
Energy Density	100–160 Wh/kg	30–50 Wh/kg	120–180 Wh/kg	Three times that of lead-acid, and close to that of LFP
Safety	Moderate	Excellent	Moderate	Overall similar to LFP ; and can be discharged to 0V.
Application Areas	Automotive, low-voltage application, etc.	Low energy density, insufficient for EV needs, narrow application range	Automotive, energy storage, low-voltage application, but poor low-temperature performance	Suitable for cost-sensitive applications with low energy density requirements, Like start-stop, Auxiliary application
Bom Cost	Moderate, lower than LFP cells	Low	High	LFP> Sodium-ion > Lead-acid after large scale application



Comparison of technical routes of cathode materials



Cathode	Prussian Series (Blue/White)	Phosphate (polyanionic) series	Layered oxides
Gram Capacity	70-160mAh/g	90-110mAh/g	100-140Ah/g
Compaction Density	1.3-1.6	1.8-2.4	2.8-3.3
Cycle Life	Good	Excellent	Good
Thermal Stability	Good	Excellent	Ordinary
Application	Large-scale energy storage , On-board start-stop etc.	Energy Storage, On-board start-stop etc.	Electric Bicycle, A00 car, On-board start-stop etc.
Pros	Low cost High performance	High stability High safety	High energy density Simple production process
Cons	Harsh production process Moisture sensitivity	Low energy density	Low thermal stability
Camel cell product layout	Cell material formula level	Pouch cell Cylindrical cell	Cylindrical cell



Camel Sodium-ion Cell Product Specification



➤ NFPP-type pouch and cylindrical series product specifications

型号/Model	NFP-90150145	NFR46145
额定容量 Rate Capacity	10 Ah	13 Ah
能量密度 Energy Density	> 90 Wh/kg	> 85 Wh/kg
ACR	≤0.8mΩ	≤0.65mΩ
标称电压 Nominal Voltage	2.85V	2.85V
工作温度 Operating Temperature Range	-40°C ~ 80°C	-40°C ~ 80°C
工作电压范围 Operating Voltage Range	1.5 V ~ 3.65V	1.5 V ~ 3.65V
低温性能 Low Temperature Performance	CCA: 10C -18°C 30S Vcell > 2.2V	CCA: 10C -29°C 30S Vcell > 1.8V CCA: 20C -18°C 10S Vcell > 2.0V
倍率性能 Rate Performance		
循环性能(25°C 1C 100%DOD) Cycle Life	2000 cycles ≥ 80% SOH	3000 cycles ≥ 80% SOH
循环性能(45°C 1C 100%DOD) Cycle Life	/	1500 cycles ≥ 80% SOH
应用场景 Application	12V/24V启停/辅助、UPS 12V/24V start-stop & Auxiliary battery、UPS	12V/24V启停/辅助、UPS 12V/24V start-stop & Auxiliary battery、UPS



Zero swelling
All tabs structure



Pouch cell
Flexible dimensions

▪ Performance can be customized according to customer requirements

Camel Sodium-ion Cell Product Performance

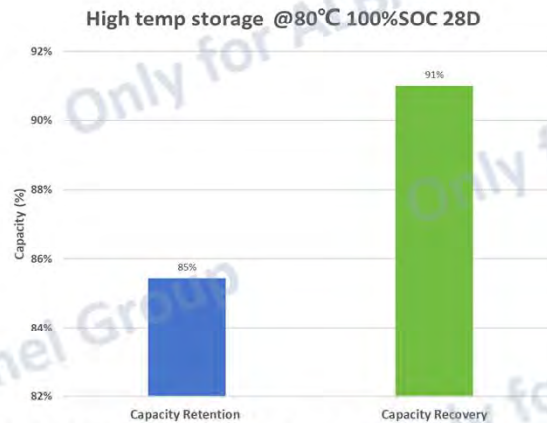


Key electrical performance:



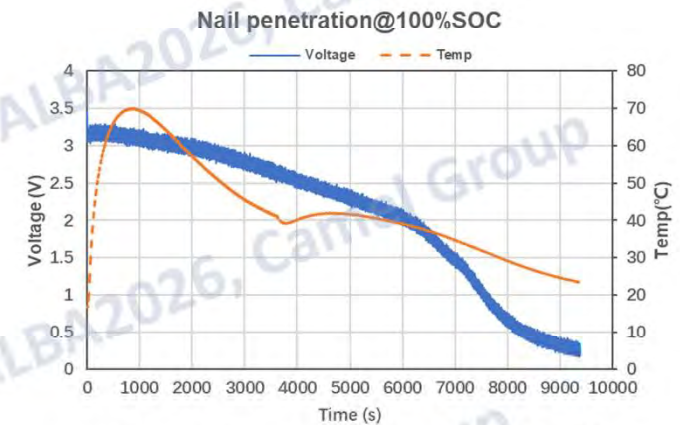
- Cold cranking: -18°C 20C 10s

$V_{min} > 2.0V$



- 80°C Storage: 100%SOC 28D

Capacity Recovery > 90%



- Nail Penetration: 100%SOC

No fire No explosion

- ✓ **Suitable for both high and low temperatures:** -40°C~80°C temp range use, -18°C 20C cold cranking and 80°C storage
- ✓ **Super safety performance:** 100%SOC nail penetration passed with both pouch and cylindrical cell
- ✓ **Adjustable size:** pouch cell design or all tabs cylindrical design, flexible and adjustable dimensions;

Camel Sodium-ion Battery Product Specification



NFPP-type battery product specifications

型号/Model	12V-40Ah	12V-60Ah
额定容量 Rate Capacity	40 Ah	60 Ah
尺寸 Dimension	SIB-H5(LN2) 242*175*190	SIB-H7(LN4) 315*175*190
标称电压 Nominal Voltage	11.2V	11.2V
工作温度 Operating Temperature Range	-20°C ~ 80°C	-20°C ~ 80°C
冷启动电流 CCA	660A	800A
重量 Weight	7.3±0.3kg	10±0.5kg
通讯方式 Communication method	CAN、Optional Bluetooth or 4G	CAN、Optional Bluetooth or 4G
防护等级 Protection Level	IP67	IP67
应用场景 Application	替代60Ah AGM铅酸电池 Replacement 60Ah AGM lead-acid battery	替代80Ah AGM铅酸电池 Replacement 80Ah AGM lead-acid battery



12V 40Ah battery



12V 60Ah battery

- This product has been officially released and is being sold on the market.

Comparison between Sodium-ion and lead-acid batteries



NFPP-type battery product specifications

Model	12V Na-ion Battery	12V Lead-acid Battery	Conclusion
Capacity	40 Ah	60 Ah	Na-ion Battery has higher energy density
Weight	7.3Kg	18Kg	
Dimension	242*175*190 LN2	242*175*190 LN2	
Energy Density	62 Wh/Kg	40 Wh/Kg	
Cycle lifetime	≥2000 cycles (100%DOD)	≥600 cycles (50%DOD)	Na-ion Battery has 3~4 times cycle life compared with lead acid battery
Cold start performance	-18°C 660A CCA V > 7.5V	-18°C 660A CCA V > 7.5V	Similar cold start ability
Low temp power performance	15C	9~11C	Na-ion battery has better power performance at low temp
Over discharge performance	Excellent Can be deep discharged	Poor	Na-ion battery has better deep discharge performance
Cost	High	Low	During the verification phase of new technology promotion, the cost of single Na-ion battery is higher than lead acid battery

Camel Sodium-ion Cell Product Specification



O3-type cylindrical series product specifications

型号/Model	NNR46145E	NNR46145P
额定容量 Rate Capacity	20 Ah	18Ah
能量密度 Energy Density	> 120 Wh/kg	> 110Wh/kg
ACR	$\leq 1.2\text{m}\Omega$	$\leq 0.7\text{m}\Omega$
标称电压 Nominal Voltage	3.1 V	3.1V
工作温度 Operating Temperature Range	-40°C ~ 65°C	-40°C ~ 80°C
工作电压范围 Operating Voltage Range	1.5 V ~ 3.95V	1.5 V ~ 3.95V
低温性能 Low Temperature Performance	-40 °C $\geq 84\%$	CCA: 15C -29°C 30S Vcell > 1.9V
倍率性能 Rate Performance	室温 5 C 持续放电 Continuous 5C discharging	
循环性能(25°C 1C 100%DOD) Cycle Life	2000 cycles $\geq 80\%$ SOH	3000 cycles > 80% SOH
循环性能(75°C Thermal stability test-SAEJ2801) Cycle Life	/	10 units > 94% SOH -18°C 13C Cold start > 2.4V
应用场景 Application	低速电动车、便携家储等 Low speed electric vehicles, portable home storage, etc	12V车载启停、UPS 12V start-stop battery、UPS



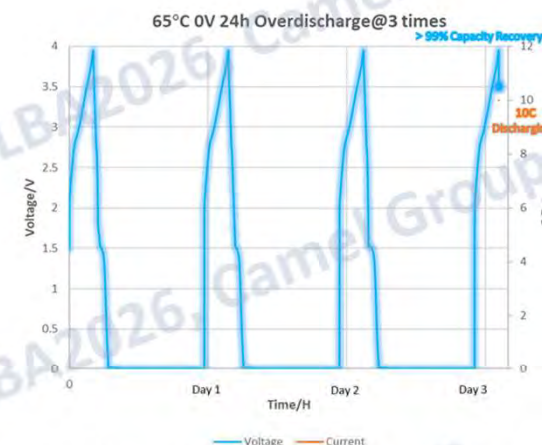
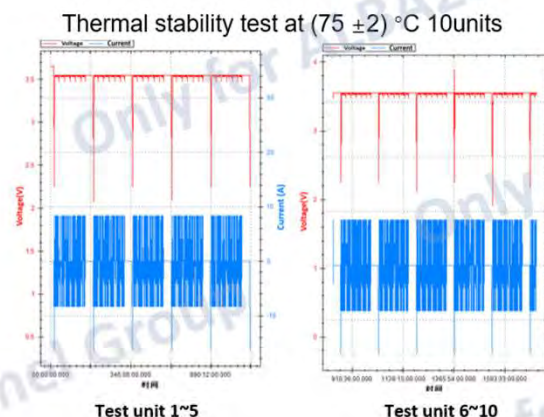
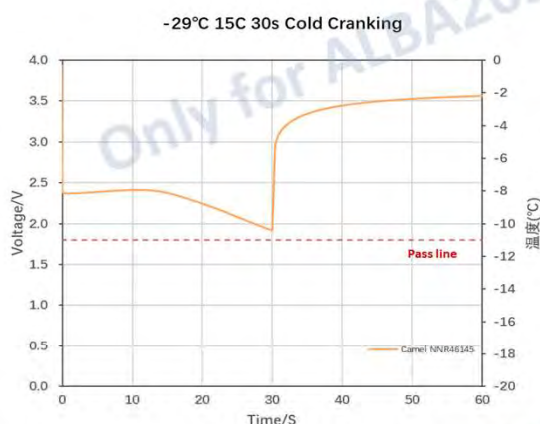
Zero swelling
All tabs high power structure

Performance can be customized according to customer requirements

Camel Sodium-ion Cell Product Performance



Key electrical performance:



- Cold cranking: -29°C 15C 30s

$V_{\min} > 1.9\text{V}$

- 75°C Thermal stability test: 10 units

Capacity Retention > 94%

- Over discharge: 65°C 0V 24V

Capacity Loss < 0.1%

- ✓ **Suitable for both high and low temperatures:** -40°C~80°C temp range , -29°C cold cranking and 80 °C storage
- ✓ **Long cycle life:** room temp cycling > 3000 cycles @80%SOH, 75°C thermal stability test 10units @94%SOH
- ✓ **Adjustable size:** all tabs design, flexible and adjustable dimensions;



Camel Sodium-ion Battery Product Specification



➤ O3-type battery product specifications

型号/Model	12V-54Ah
额定容量 Rate Capacity	54 Ah
尺寸 Dimension	SIB-H5(LN2) 242*175*190
标称电压 Nominal Voltage	12.4V
工作温度 Operating Temperature Range	-30°C ~ 80°C
冷启动电流 CCA	680A
重量 Weight	≤8kg
通讯方式 Communication method	CAN、Optional Bluetooth or 4G
防护等级 Protection Level	IP67
应用场景 Application	替代68Ah AGM铅酸电池 Replacement 68Ah AGM lead-acid battery



12V 54Ah battery Prototype

- This product is currently being developed in collaboration with the OEM.